AMERICAN MACHINIST

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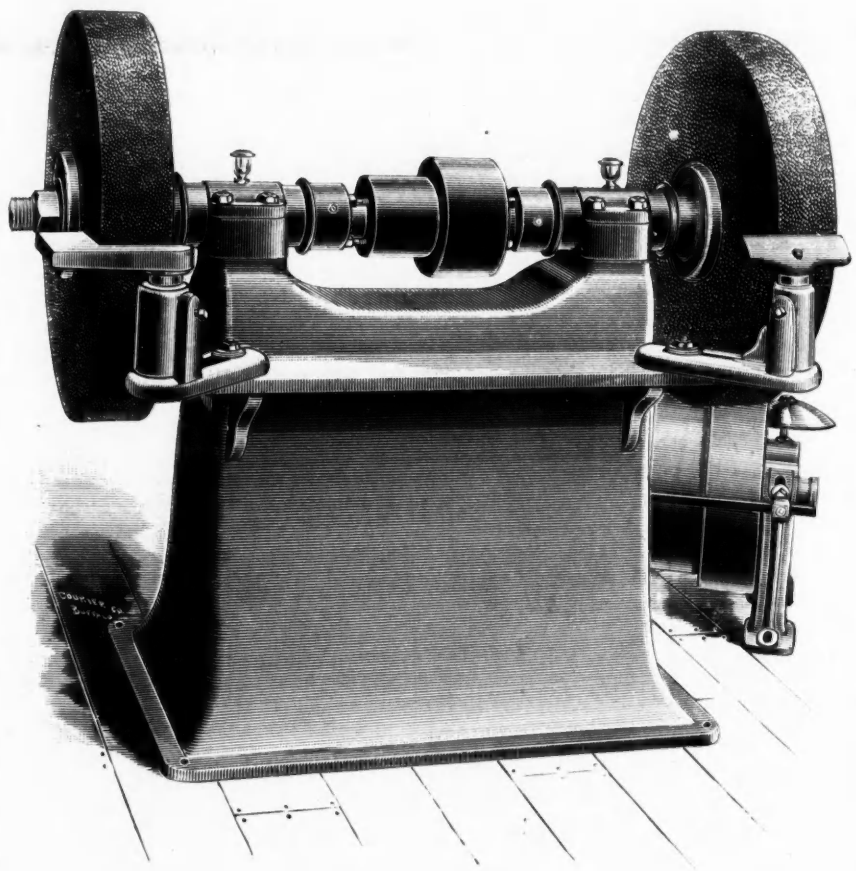
Heavy Floor Emery Grinder.

We illustrate with this cut, a heavy machine designed for carrying large wheels in foundries, machine shops, railway repair shops, etc. The base is heavy, with sufficient flare to give a solid floor foundation, which prevents vibration when being used. The machine has steel spindle long enough for a man to work at each end at the same time. It has self-oiling boxes of improved design, dust-proof, with an arrangement to take up the wearing away of the boxes, by means of set screws. A raised V prevents the oil from getting on the wheel. This machine will run wheels up to 36 in. diameter without the tremble there is on the lighter machines that large wheels are usually run on. Manufactured by Springfield Glue & Emery Wheel Co., Springfield, Mass.



HEAVY FLOOR EMERY GRINDER.

Modern Locomotive Construction.

BY J. G. A. MEYER.

FIFTY SIXTH PAPER.

The driving boxes shown in our last paper were proportioned to suit one particular class of locomotives, namely, eight-wheeled passenger engines. From our remarks in that paper it will be seen that the size of a box for a passenger engine depends upon the weight on the drivers; and since the cylinders are proportioned in accordance with the weight on the drivers, we may assume and say, as our illustrations indicate, that the size of a box depends upon the diameter of the cylinder used.

In mogul, ten-wheeled and consolidation engines the diameter of cylinder is also proportioned in accordance with the weight on drivers; but under any one of these engines there are more driving wheels than under an eight-wheeled passenger engine, and consequently the size of the axle box suitable for an eight-wheeled passenger engine, with cylinders of given diameter, may or may not be suitable for a mogul, ten-wheeled or consolidation engine having cylinders whose dimensions are equal to those of the cylinders in the passenger engine. It therefore remains for us to consider the surrounding conditions of the axle box and journal, and the service to which they may be subjected under freight engines, thereby enabling us to determine a suitable size of driving-axle journal, and select the proper size of driving box, from the number shown in our last paper. In mogul, ten-wheeled and consolidation engines, as well as in passenger engines, the weight on the journals must be distributed in a manner so as to prevent heating; and the rules given for finding the dimensions of the driving-axle journal for a passenger engine may also, with a slight change, namely, less pressure per square inch on the projected area of the journal, be used for computing the dimensions of driving-axle journals in the other classes of engines.

Fig. 345.

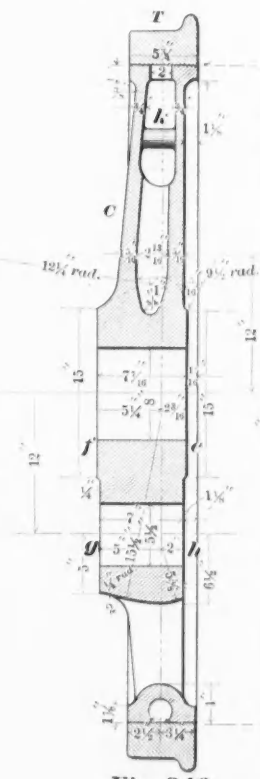


Fig. 346.

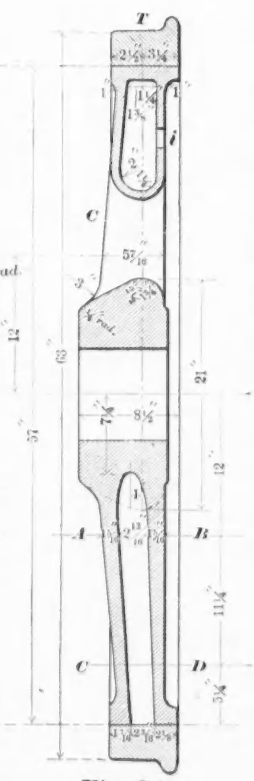


Fig. 347.

MODERN LOCOMOTIVE CONSTRUCTION.

From the foregoing we learn that in all locomotives the driving-axle journals are proportioned to the pressure due to the weight on the driving wheels, and when this is correctly done, a sufficient allowance will then have been made for the pressure due to the load which the engine has to haul; we therefore leave the load to be hauled, out of consideration in the calculations. In determining the sizes of journals for mogul, ten-wheeled and consolidation engine, we must not lose sight of the fact that, in these classes of engines, particularly in mogul and consolidation locomotives, the driving wheels are smaller in diameter than those in eight-wheeled passenger engine, and consequently the axles are brought closer to the track and exposed more to the dust, and thereby raising conditions favorable for cutting the journals. Again, it often happens that, on the road, the counterbalance weights are in the way of oiling the journals, and therefore, if the time is limited, it may happen that the oiling of some of the journals will be neglected. These classes of locomotives are also more or less looked upon as freight engines, and do not always receive the same care as bestowed upon passenger engines. For these reasons it is always advisable to make the journals for freight engines comparatively large in diameter. We therefore recommend that their driving axle journals shall be proportioned in a manner which will not allow more than 160 pounds per square inch on the projected area of the journal; in fact, 160 pounds should be the limit, instead of 175 pounds, as given for passenger engines, and when the design or other given conditions will allow, the pressure per square inch on

the projected area of the driving-axle journal should be less than 160 pounds.

The dimensions of driving-axle journals in the following tables are recommended. The pressure per square inch on the projected area of these journals will be less than 160 pounds, when the weight of the engines correspond to the weights given in Tables 5, 6, 7 and 8:

TABLE 16.

Dimensions of driving-axle journals for mogul engines.

Diameter of Cylinders.	Diameter of Journals.	Length of Journals.
11 inches.	5 inches.	6½ inches.
12 "	5½ "	6¾ "
13 "	5¾ "	7¾ "
14 "	6 "	7¾ "
15 "	6½ "	7¾ "
16 "	6¾ "	8 "
17 "	6¾ "	8 "
18 "	7½ "	8 "
19 "	8 "	9 "

TABLE 17.

Dimensions of driving-axle journals for ten-wheeled locomotives.

Diameter of Cylinders.	Diameter of Journals.	Length of Journals.
12 inches.	5 inches.	6½ inches.
13 "	5½ "	6¾ "
14 "	6 "	7¾ "
15 "	6 "	7¾ "
16 "	6½ "	7¾ "
17 "	6¾ "	8 "
18 "	7½ "	8 "
19 "	8 "	9 "

TABLE 18.

Dimensions of driving-axle journals for consolidation locomotives.

Diameter of Cylinders.	Diameter of Journals.	Length of Journals.
14 inches.	5 inches.	6½ inches.
15 "	5½ "	7¼ "
20 "	7½ "	8 "
24 "	8 "	9 "

Although there are many locomotives with cylinders of the same diameters as given in these tables running with smaller journals, yet the dimensions of the journals in the tables agree with the average sizes of journals in some of our modern locomotives.

For the sake of comparison, we append Table 19, in which are given the dimensions of a few driving-axle journals in modern locomotives doing excellent service:

TABLE 19.

Class of Locomotive.	Dimensions of Cylinders.	Diameter of Driving Axle Journal.	Diameter of Main Driving Axle Jour.	Length of Journals.
Eight-wheeled Passenger	17" x 24"	7½ in.	7¾ in.	8 in.
" "	18" x 24"	8 "	8 "	8½ "
" "	18" x 24"	8 "	8 "	12½ "
Moguls	18" x 24"	7½ "	7¾ "	8 "
Ten-wheeled	18" x 24"	7½ "	7¾ "	8 "
" "	19" x 24"	7½ "	7¾ "	8 "
Consolidation	20" x 24"	7½ "	7¾ "	8 "

In Table 19 it will be seen that in some of the locomotives the journals of the main driving axle, that is, the axle to which the connecting rods are attached, are made ¼ of an inch larger in diameter than the other driving axle journals. Although this is good practice, there are master mechanics who object to such an arrangement, because it compels them to keep, for each class of engine, two sizes of driving boxes on hand ready to replace worn-out ones, and thereby increasing the stock which must be kept to facilitate quick repairs.

The dimensions of the driving axle journals given in Tables 16, 17 and 18 also establish the sizes of driving boxes; and consequently we have only to select from the number of boxes shown in our last paper, that box which will fit the journal to be used.

When the kind of driving box which is to be used has been determined upon, we then select the corresponding pedestal from the number of pedestals shown in the forty-ninth paper. It should be remembered that the dimensions of the upper braces marked B_2 and the lower braces marked L, uniting the pedestals, were computed to suit the diameters of the cylinders; and therefore, in frames for freight engines, the braces uniting the pedestals will be heavier when compared with the pedestal than shown in the illustrations. To make this plain, we will take the one example. Let it be required to find the principal dimensions of a frame for a consolidation engine with cylinders 20 inches in diameter. In Table 18 we see that the driving axle journal must be 7½ inches diameter and 8 inches long, hence the box to be used is that one which is represented by Fig. 317; and the pedestal to be used for this box is represented by Fig. 272. But now, the dimensions for the upper and lower frame braces must be determined according to Rules 32, 34 and 35, to suit a cylinder 20 inches in diameter, and consequently these braces will be heavier than shown in Fig. 272, but the dimensions of the pedestal itself will remain as they are given. There, too, are a few cases in which the choice of the axle box will either compel us to change the width of frame suitable for a given diameter of cylinder as established in the illustration of pedestals, or we must increase the width of the axle box to suit the given width of frame.

Section through C. D.

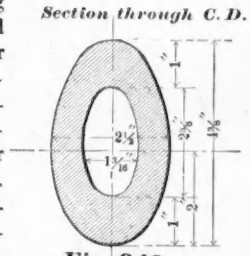


Fig. 348.

Section through A. B.

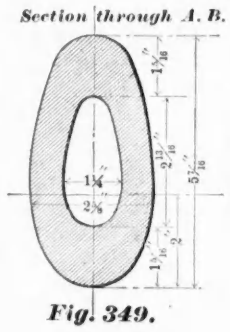


Fig. 349.

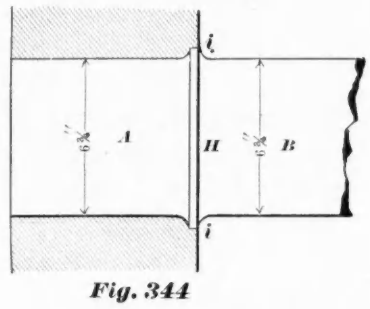


Fig. 344

that of the journal should never be greater than ⅛ of an inch, as this will give a shoulder sufficient for all practical purposes; on the other hand, if the difference between these diameters is greater than ⅛ inch, the axle will be unnecessarily weakened, and will be liable to break off at the hub of the wheel. Sharp corners at $f\,f$ are another cause which will lead to the breaking of the axles near the hub, and therefore sharp corners at $f\,f$ should not be tolerated; the junction between the wheel fit and the journal should always be a curve. Although this manner of forming the wheel fit A, that is, turning it to a smaller diameter than that of the journal, is quite a common practice, we believe it to be inferior to that shown in Fig. 344. In this design the diameter of the wheel fit is equal to that of the journal, and consequently the strength of the axle is in nowise impaired. The shoulder against which the hub of the wheel is pressed is formed in turning, by allowing to remain on the axle a small projection H, about 3/16 of an inch larger in diameter than that of the journal, with a flat part on the top of the projection about ⅛ of an inch wide. Here also sharp corners at $i\,i$ must be avoided and the junction between the projection and axle nicely rounded out. The hub of the wheel is counterbored to receive the projection or shoulder on the axle, as shown in the illustration. This design of an axle has an advantage over those shown in Figs. 341 342 and 343, namely, in axles with wheel fits like that shown in Fig. 344 the journal can be trued up when necessary and still leave the shoulder H unimpaired.

Sometimes we find the main axles turned to equal diameters from hub to hub of wheels, between the axle shown in Fig. 342 and that in Fig. 343 will be found in the forms of the central parts $C\,C$; in the latter it is a gradual reduction in diameter from the collar to the center; and in the former the central part C is of equal diameter throughout.

DRIVING WHEELS.

Fig. 345 represents the front view, Figs. 346, 347 sections of a driving wheel, and Figs. 348, 349, represent sections of its arms. This wheel was designed for, and is successfully used under eight-wheeled fast passenger engines with cylinders 18 inches in diameter.

A driving wheel consists of two parts, namely, the driving wheel center marked C, and the tire marked T. In this country the driving wheel centers are made, almost universally, of cast-iron. Sometimes the spokes are cast solid, but usually they and the rim are cast hollow. The crank N and the counterbalance $O\ O$ also form part of the wheel center.

The most common practice in fastening the tires on the wheel center is to shrink them on the center. To do this the wheel centers are turned square across, (not tapered) and the tire bored out somewhat smaller in diameter than that of the wheel center. The tire is then heated, generally, on account of cleanliness, by means of a number of gas flames arranged for purpose. When the tire, by these means, has been sufficiently expanded, it is then slipped on the wheel center and allowed to cool, and thereby contracting and binding firmly around the cast-iron center.

TABLE 20.

Standard sizes of wheel centers.

Diameters of wheel centers.	Inside diameters of tires.
38 inches.	38 inches, less 0.040
44 "	44 " " 0.047
50 "	50 " " 0.053
56 "	56 " " 0.060
62 "	62 " " 0.066
66 "	66 " " 0.070

A uniformity in the diameters of wheel centers has not yet been thoroughly established. In 1886 the American Railway Master Mechanics' Association recommended and adopted the above diameters as standards.

In this table we see that, for the given diameters of wheel centers, the shrinkage allowance in the bore of the tires is 0.040, 0.047, 0.053, 0.060, 0.066 and 0.070 of an inch respectively, and are claimed to be the average of the wide range of shrinkage allowance used in actual practice.

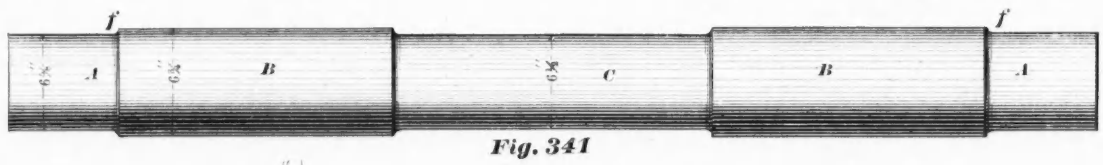


Fig. 341

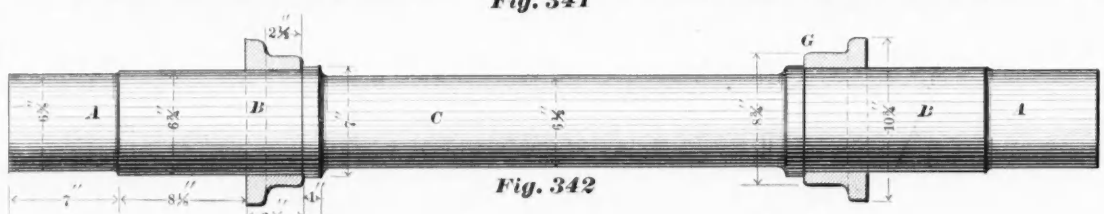


Fig. 342

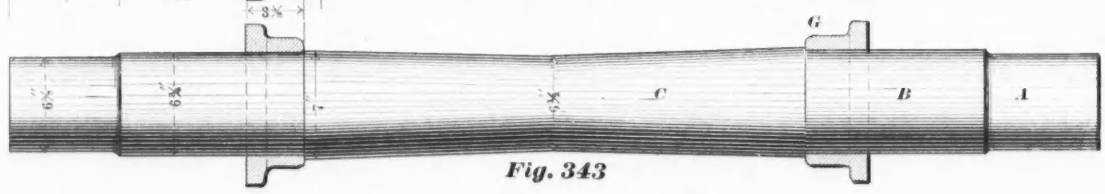


Fig. 343

MODERN LOCOMOTIVE CONSTRUCTION.—SEE PAGE 1.

DRIVING AXLES.

The driving axles are made of iron or steel; the writer prefers good hammered iron axles.

Some of the different forms of driving axles, such as are generally adopted under all classes of locomotives, are shown in Figs. 341, 342 and 343.

Fig. 341 represents a main driving axle suitable for eight-wheeled passenger locomotive, with cylinders 16 inches in diameter; a mogul engine with cylinders 16 inches in diameter; or a ten-wheeled locomotive with cylinder 17 inches in diameter. Those parts of the axles marked $A\ A$ are generally called the wheel fits, and are usually turned to ⅛ of an inch less in diameter than the journals of the axles marked $B\,B$; in fact, in this style of axles, the difference between the diameter of the wheel fit and and frequently we find the main axles formed as shown in Fig. 341. In the latter axles the central part C is left smooth forged; the parts $B\,B$ are made sufficiently long to receive the axle box and eccentrics.

Fig. 342 represents the rear driving axle of an eight-wheeled passenger engine with cylinders 16 inches in diameter. The same size and form of axles are also used under other engines under which a main axle like that in Fig. 341 is used. In these driving axles the central part C and the projections $E\ E$, which form the shoulders, are left smooth forged; the amount of projection is equal to amount of metal allowed for turning the journals B. The cast-iron collars $G\ G$ are either shrunk on the axle, or held in position by two set screws. Occasionally we find the driving axle made as shown in Fig. 343. The only difference

A Texas correspondent writes us in regard to a circular in which an importer offers to sell German steel shafting at 2¾ cents per pound. Our correspondent thinks a duty should be inposed upon such products, to protect American producers. We do not well see how this could get in short of a duty of 45 per cent., which would seem to indicate very cheap production.

An article headed "Jefferson as a Workman" is going the rounds of the press. In this it is detailed how the great statesman worked away with a good deal of industry, in his leisure hours, at various inventions more or less mechanical in their nature. But he never appears to have succeeded in any degree in his mechanical work. The moral appears to be that it requires ability and training to be a skilled mechanic, as well as it does to be a great statesman.

Condition and Prospects of the Machinery Business.

LETTERS FROM PROMINENT ESTABLISHMENTS TO THE "AMERICAN MACHINIST."

The Hewes & Phillips Iron Works (Corliss Engines, Boilers, etc.), Newark, N. J., write us:

We are pleased to state that the year of '87 has been a very satisfactory one to us; our sales show an increase of 25 per cent. over the year of '86. While prices have been exceedingly low and competition keen, our business has, on the whole, been fairly remunerative. Wages have ruled about 10 per cent. higher on the average than those paid during '86, and material has remained about the same.

We have built 6 of our Corliss compound condensing engines during the past year, ranging from 300 up to 1,000 horse-power and a large number of the non-condensing type; in fact our engine business has increased to such an extent that we have been compelled to build a large erecting shop with over head traveling crane, and numerous other appliances for handling our heavy work. We have also put in a large pit lathe capable of turning a fly wheel 30 feet diameter by 12 feet face. In addition to this we have put in a large number of other labor-saving tools, both in our machine and boiler shops, and think now that we have one of the best equipped shops in the country.

The prospects for 1888 we consider very flattering, and if Congress will but refrain from tariff tinkering and agitation, we think the volume of business will be both large and profitable.

Hilles & Jones (Boiler Makers and Bridge Builders' Tools), Wilmington, Del., write us:

We can say the past year has been a very busy one with us, but with our increased facilities we have been able to make quicker deliveries than in former years. The volume of our business has increased very much, but prices have been low, not having advanced with material and labor. There is a constant demand for first-class labor-saving machinery, and we consider the outlook good for the coming year, if not affected by the questions of tariff and trade unions.

C. F. Baker (Common-Sense Oil Filters and Boiler Cleaners), Minneapolis, Minn., writes us:

I spent the first half of the year in perfecting my filter and getting ready for manufacture in large quantities, and did not put many on the market till late in the summer. They seem to fill the proverbial "long felt want" and from the present steadily growing demand I anticipate a business for next year that will necessitate an enlargment of facilities for manufacture.

The Stiles & Parker Press Company, (Presses, Dies and Sheet Metal Tools), Middletown, Conn., write us:

On the 4th, of last Feb. our Middletown factory was almost destroyed by fire. We have since temporarily occupied the factory buildings adjoining our own premises, which happened to be vacant at the time, besides rebuilding and erecting some new buildings. These shops we have filled with a plant of the very best tools we could buy, a number of them having been specially constructed to meet our peculiar requirements. In May last we bought ½ acre of land—nine city lots—at the corner of 144th street and R. R. Avenue, adjoining the Mott Haven Canal, thus giving us both water and railroad facilities. Here we proposed to locate our entire works, and a building was commenced in September, but before the foundation piles were all in place, our attention was called to plans on exhibition at the Park Department, for sinking the Harlem railroad tracks and bridging the streets, which if carried out, would put our buildings a story and one half under ground. This caused us to postpone building until something definite could be learned. We had bought last spring a large lot of machinery, that was being held for us until the new shop should be finished. As we much needed these tools, we built a one-story shop 200 feet long on the site of our old building, which we shall occupy for the present. With these added facilities we are thus in many respects better able to do work with speed, accuracy and economy than we were before the fire. Most of our patterns being destroyed, we have re-designed all our standard tools, making them heavier and larger all over, besides adding a number of such improvements as, in the light of our long experience, with sheet metal machinery, seemed to be desirable. As a result of these changes we believe that our presses in their present shape represent the most advanced types and best experience in this class of machinery. Ever since our fire, which found us with a large amount of work on hand, we have had all the orders we could fill, and we think the outlook for next year's business is quite as promising. At our New York branch, 207 Centre street, business during the past year has been constantly increasing and the outlook there for the coming year is also quite as promising.

The Gage Tool Company (Self-Setting Planes, etc.), Vineland, N. J., write us:

The sales of our new self-setting bench planes are increasing. Those who buy and use them do not hesitate to commend them in the highest terms, and with our determination to maintain our standard of excellence we look for a constantly increasing business. We have succeeded in procuring steel of such quality and so tempering it that we can plane over the hardest hemlock knot many times, and then without sharpening the bit cut a hair as with a razor. The patent self-setting arrangement also gives great satisfaction; it is the only plane that is self-setting.

The National Machinery Company (Specialists in Bolt and Nut Machinery), Tiffin, O., write us:

We are glad to say that 1887 has been the largest year of business to us that we have yet had, exceeding by a few thousands that of '82. Our line of manufactures has been very much improved and extended since '82, which partially accounts for this, and our facilties are a good deal better. We are employing over 100 hands, and expect to add a new line of tools in '88, which will increase our production. The prospects ahead seem very encouraging. Prices are a good deal lower and margins closer. Undoubtedly competition in the tool business is going to be very great in the future. Have made no enlargements to speak of, except a tumbling barrel and cleaning department, but expect to require to add considerably this year. Would have done so before this, but for the difficulties attending manufacturing, and in a small town unaccustomed to the wants and care of manufacturing interests.

The improvements of our line of machinery (namely bolt and nut machinery) has been our constant care, and our latest improvement on bolt headers and upsetters, we believe will place those where we cannot see much room for betterment. It will be the greatest improvement made for many years. We will soon be ready to market them. The demands of the railroad interests for tools which will facilitate manufacturing their iron work, are calling for a class of machinery combining the hammer, punch, shears and drop forge; this our new line of headers will do. Work which we would have believed impossible at one time to have been done on a heading tool is now a simple process, and much harder work still called for.

The Fitchburg Machine Works (Metal Working Machinery), Fitchburg, Mass., write us:

The volume of our business for the past year has been over 33⅓ per cent. larger than for 1886, and if the capacity of our works had permitted we would have made a still larger gain over the previous year.

We have enlarged our works during the past year, adding new and improved tools, so that, with the beginning of the new year, we are prepared to turn out better work and more of it than ever before. We have had considerable trouble in getting good first-class machinists; there are always plenty of men who know about half the trade, but it is seldom that we have a chance to hire a man who knows how to do a good job and who can be relied upon to do that every time.

We have not brought out any new tools during the past year, but are all the time making improvements on those we have. During the three dull years we had previous to 1887, we kept very busy in our drafting room and pattern shop, changing over our patterns and improving our tools in various ways, and our business for the past year shows that these changes are appreciated by our customers. We commenced early in the year 1887 to change and rebuild our planer patterns. We have not been able to get them all completed, but those we have placed on the market have given the best of satisfaction, and we feel confident that our sales will increase sufficiently to pay us for the expense of making the change.

Prices have ruled very low for the past year; in many instances the margins have been so slight that it was almost a question if it was not more profitable to not do the work at all. The indications are that we shall be able to get better prices for our tools in the near future.

We think that the indications for good business in our line of manufacture for 1888 are excellent, and with our increased facilities we hope to make a better showing than we have been able to do for the past few years.

Our motto is now, as it ever has been, to make our tools as good as the best, and by devoting our whole time to our special line of manufacture we intend in the future, as in the past, to be excelled by none.

Randolph Brandt (Selden Patent Packing, and Mine, Mill and Steamship Supplies), New York, writes us:

From the middle of January to October, it was a constant drive to fill our orders for "Selden packing," and during the last three months trade has been good. In the early part of December I made a Western trip, taking in the large distributing centers East of the Missouri River, and found a very encouraging feeling for '88.

T. Shriver & Co. (Iron Castings of all kinds), New York, write us:

The business of the year has been up to the average, but what with large advance in wages, and higher prices for material of all kinds, and no advance at all in prices of our manufactures, we do not think that our report could have interest for any one. All the same we expect to do a large business the coming year.

E. Gould & Eberhardt (first-class Machine Tools), Newark, N. J., write us:

Our volume of business for '87 has been about twenty-five per cent. over '86, and we have been kept busy on our general line of machine tools, although our shapers, automatic gear cutters, and Eberhardt's new drill presses have added quite considerable to our output, among which was considerable for export.

We have increased our facilities, and added improved methods, and are continuing to improve our class of machine tools. Inquiries continue fair to brisk, and the demand for rock bottom prices has not fell off yet. We have no reason to complain, and hope the new year will bring plenty of business to machine tool manufacturers.

L. S. Starrett (Improved Fine Tools for Mechanics), Athol, Mass., writes us:

During the past year I have added some very valuable tools to my former list; among which are a micrometer caliper, a universal bevel protractor, solid hardened edge steel squares, and new extension dividers. I have also remodeled my surface gauge. I have bought out the Fay's patent and Yankee calipers and dividers, including the entire plant for their manufacture, and have perfected a new quick adjusting spring nut for calipers and dividers.

My trade for the past year has greatly increased and extended both at home and abroad, and prospects for continued success never were better.

The Long & Alstatter Company (manufacturers of Punching and Shearing Machinery), Hamilton, Ohio, write us:

Our business in punching and shearing machinery has been better during the past year than ever before.

We have employed about twenty-five per cent. more hands than ever before, and have added to our capacity by the purchase of new machine tools, and the enlargement of our foundry.

We have numerous orders and inquiries on hand, and think the prospect for next year's business is excellent.

We have added to our productions several very large and heavy machines, one of them capable of cutting off 3 inch square tool steel, and one to punch a 4 inch hole through 2 inch steel in the center of a sheet 8 feet wide. These machines are steam driven.

We are also building what are called "expanded metal machines," used chiefly for making steel fence. Some of these machines have been shipped *via* London to Australia, where the fence made by them is used to fence out rabbits.

The Union Stone Company (Emery Wheels, Grinding and Polishing Machinery and Supplies), Boston, Mass., writes us:

We have in several ways increased the facilities of our works, by the addition of new machine tools and apparatus for the manufacture of both machinery and emery wheels.

We are occupying some 2,000 feet more floor space than we did Jan. 1st, 1887.

The business for 1887 has been very satisfactory and a large number of orders held over.

The Page Belting Company, Concord, N. H., write us:

The year now closing has been one of very satisfactory prosperity to us. During the time we have very largely increased our production by the addition of increased facilities; but at the same time this increase of production has hardly kept pace with the increased demand for our manufacture. Our trade has extended into many new markets in this country, and enlarged very materially in markets previously occupied. We have opened up some new foreign trade in Germany and other European countries.

There has been no labor disturbance during the year; in fact, we have never had any trouble at all with our employes.

Prices of labor are not changed. Materials in some lines are higher, so that the cost on belting is increased over what it was one year ago.

The Bickford Drill Company (Machinists Tools), Cincinnati, O., write us:

We took charge of our shops on April 1st, 1887, having bought out Mr. H. Bickford, and in these nine months we have done a fair business. We have made a good many changes in our shop since taking possession, and we expect to make still more changes and improvements in our tools and fixtures next year. We look forward to a good business for 1888. We find raw material higher in price than it has been for some time, but the margin on finished machinery is quite small, owing to the sharp competition.

The M. C. Bullock Manufacturing Company (Diamond Pointed Rock Drills, Lane's Patent Band Friction Hoists, Wire Rope Haulage of Cars, Pumping and General Mining Machinery, Straight Line Engines), Chicago, Ill., write us:

The volume of our business has been satisfactory, and with a marked increase for our diamond-pointed prospecting drills and standard band friction hoisting machinery. While there has been a little dropping off of business in the past two months, there is now an unusual amount of inquiry that speaks well for the coming season. Prices have been rather unsatisfactory, owing to competition with lighter and inferior machinery. We have added quite a number of heavy tools to our equipment, greatly increasing our output and our ability for filling orders. We have brought out several new styles and sizes of our improved diamond drills, hoisting machinery and engines.

From our outlook, the proposed tinkering with the tariff is unfavorable to all connected with the iron industries, but we have too great faith in the stability and ability of American metal workers to be seriously alarmed about the matter.

Literary Notes.

GENERAL SPECIFICATIONS FOR HIGHWAY BRIDGES OF IRON AND STEEL. By J. A. L. Waddell, Consulting Engineer, Kansas City, Mo, Published by Macdonald & Spencer, Kansas City, Mo.

The author of this pamphlet is also the author of a more pretentious work, published by the Wileys, on "The Designing of Ordinary Highway Bridges," which work has been highly commended by the press and by eminent engineers. He is somewhat of an enthusiast—in a good sense—on the subject, and the present pamphlet is manifestly put forth with a desire to awaken interest in a matter that has never received the attention it deserved.

The author argues strongly for reform in the whole matter of highway bridges, and strengthens his argument by an array of bridge failures, and by letting light on how the contract for building highway bridges is sometimes let; also by showing the faulty manner in which the work is often done. His remarks on "How Bridges Ought to be Built" cover in a concise and plain manner the principal details.

The argument in favor of an association of highway bridge builders deserves especial attention.

About one-half the pamphlet is devoted to general specifications for bridges, and remarks upon their application. These specifications are very complete, and together with remarks concerning their application, contain a good deal of general as well as special information—information in which those who have to do with iron structure of any kind will be interested. The price of the pamphlet is only twenty-five cents.

Gondola cars of 60,000 pounds capacity are being built at the Altoona shops of the Pennsylvania railroad.

Pulleys and How to Make Them.

By S. Bolland.

When a firm contemplates making a new set of pulley patterns it is very essential that more than one system be considered. But very often such is not the case, the whole set, from the largest to the smallest, being made after the same model, only to be repented of after the expense has been incurred of making patterns which are not, by any means, the best for the purpose. It is also very interesting to observe how various are the methods of moulding from the same pattern—as I shall show further on.

If I should enter a foundry and see a man preparing to lift the upper half of the inside of a 6-foot pulley, 12 inches deep, with gaggers and cheeks and was informed that the pattern from which he was moulding was a straight rim with loose arms, and that this was their regular system of making such a pulley, I should at once conclude that it would be best for that firm to buy all their pulleys from the specialist, and the sooner they began to do so the better.

As before stated, there are many kinds of patterns. For example, we have the straight rim with loose arms; an excellent plan, because of the facility with which rims of any width desired can be made from them, by simply setting the arms in position to be central after the rim has been drawn to the width required. A sectional view of such a pattern is shown at Fig. 1.

Then again we have the pattern with the arms either cast to the rim or secured to it after it has been turned true on both faces, and good draught allowed on the inside—Fig. 2; also those made in halves, as shown at Fig. 3.

Fig. 4 shows another form, being simply the top half of rim, loose from the body.

We have in these selections a goodly array to choose from, and whilst, in my opinion, the one shown at Fig. 1 is the best for general purposes, we cannot afford to ostracize the rest, for, as I shall presently demonstrate, they all possess merits peculiar to them, which cannot be denied nor be dispensed with, if we would make the best of our opportunities.

Beginning in their order, as above described, we will proceed to analyze the several methods by which we can make pulleys from the loose arms and rim. Fig. 5 is a full view of such a pattern—6 feet diameter, 12 inches deep. The inside is rammed up to the joint of the arms, and the lifting plates or arbor set down thereon. It will be seen that all these plates are bound together by clamps which are cast in when the arbor is made, as also are the three lifting staples *A*, *B* and *C*. Unlike most arbors of this kind which I have seen, I choose to have the flat side of the plates down on the bed, as shown, because it is so much easier to make the joint. To make an arbor like this, place the arms on a true bed and mark off the clearance all around. This impression will be taken on the cope, which must be rammed on the bed. After the cope is lifted off, as many feet or guide pins as are requisite can be set in, the marks serving as guide to place them. Be sure and make them large, so as to have good taper and plenty of length.

Fig. 6 shows a section of plate, with foot *A*. The pattern for the plates can now be bedded to the lines on the bottom, after which the clamps and staples can be sunk in their places. Be careful to have the ends of the clamps clean and well jagged, to take a good grip of the iron, or they will soon jar loose. Another important item is to have the connecting clamps strong; otherwise it will soon be twisted out of shape. With such a rig as this, pulleys can be made very readily.

Of course I am now speaking of such as have but one set of arms. When one with double arms is to be made the bottom set of plates must be cast separate, on account of their withdrawal when the pulley is cast. If two sets of arm patterns are supplied, cast nuts in the loose bottom plates to correspond with holes in the arbor plates, through which bolts can be inserted to bind the two sets of plates together, after the top set of arms has been taken out and that portion of the mould finished.

I incline to the opinion that no particular advantage accrues from the use of two sets of arms, for all that is needed to accomplish the job with one set is to cast three studs on the back of each of the bottom plates long enough to give a sufficient body of sand over the arms. A staple is also needed in the center of the plate which is to pass through a spider made to rest on the studs. A key can then be driven home between the staple and spider, and all will be secure. I have shown this arrangement in plan and elevation at Figs. 7 and 8. It will be seen that the whole rig can be keyed together off the mould and used after the manner of the upper arbor. In this case the rim will have to be drawn out of the mould after the ramming has reached the height of the spider, and placed back again after the arms have been taken out, the mould finished, and the upper portion of mould set down in place. The keys can now be knocked out, the spider lifted away, and the mould proceeded with in the usual manner.

Although the arbor just described is a good one, and has many admirers, yet all admit its liability to warp out of form, so that it would appear that there still remains room for improvement. Fig. 9 is the sketch of an arbor which can be used very readily for all sizes from 12 inches to 12 feet diameter. This arbor is perfectly rigid, and cannot possibly get out of order. A good way to make such an arbor is to make a pattern of one-half, quarter, sixth or eighth, according to size of pulley. You then have the pattern by you ready for emergencies, whereas, if they are made from rings and loose pieces, the probability is that you will have a new rig to make every time. In making this arbor cut out to clear the arms (this allows of the iron coming down on the joint), and cast on good, stout feet, with plenty of taper, as directed for the plates.

Before quitting the subject of moulding from a loose arm and straight rimmed pattern, I would call attention to an ingenious way of using it in sizes from 12 inches to 30 inches diameter. Let us suppose one 30 inches diameter and 8 inches face. The first operation is to place the rim on a face-board and set in the arms (the best method of doing this is to have a block which will not only center the arms, but will at the same time form the joint), have a three part flask with cheek same depth as the rim, ram up the outside, joint, and then ram the cope. When this is rolled over and the inside block taken out, the inside must be rammed a little higher than the rim and a parting made all over. The nowel in this instance must be barred as a cope, to suit the form of parting. Let the nowel be rammed and lifted off; the rim is now to be drawn out and the nowel put back, and after securing the three parts together, roll all back again into position. The top part can now be lifted off, and there being no rim in the mould, a good lift is absolutely certain. Pulleys up to the size mentioned can be made very rapidly this way. By consulting Fig. 10 the reader will see the complete operation at a glance. The bottom cope or nowel has been replaced after the rim was taken out. The reason for making parting *A* with a rise is to help keep the core in place when it is rolled back. A few lifters laid in the core (as shown at *B*) on the bottom side will prevent any of the mould from falling away when it is being turned back.

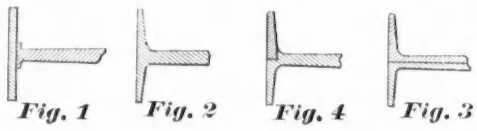


Fig. 1

Fig. 2

Fig. 4

Fig. 3

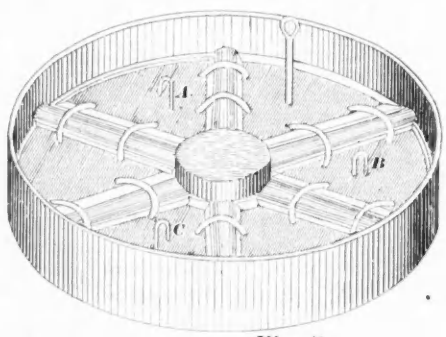


Fig. 5

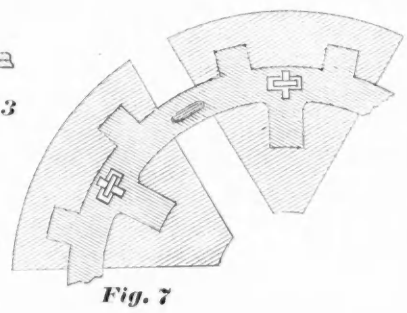


Fig. 7

Fig. 6

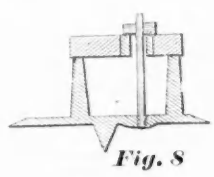


Fig. 8

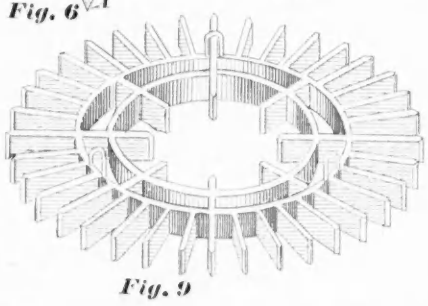


Fig. 9

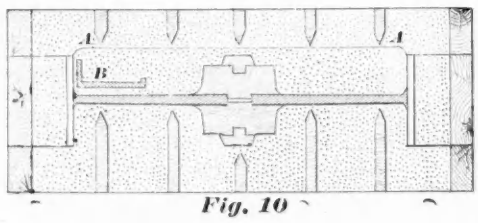


Fig. 10

Pulleys and How to Make Them.

Design and Construction of Machine Shops, Boiler Shops and Foundries.

By W. H. Hoffman.

Fourth Paper.

The boiler shops as built 40 years ago would hardly compete with any of those now in general use. The old-fashioned shop has not by any means disappeared, but the business of such boiler makers is confined to general repairs, or the construction of new work from the designs of the old and "unconverted" engineer.

Power was introduced in boiler shops somewhere about the early fifties, but to a limited extent. Punching and shearing machines driven by belts were in use in the large boiler shops in 1852, and a few of them had power rolls, the latter being usually so constructed that it was impossible to roll small flues on them.

One of the first steam riveting machines used in this country was built in 1856 by Messrs. Woodruff & Beach, of Hartford, Conn., from drawings made by the writer, and this machine was in use at that establishment for about twenty years. Steam, hydraulics, and pneumatics are now used by the successful boiler makers, each system having its advocates, and each of the three methods its own field of usefulness. For all work where the pressures on the riveted structures are to be moderate, say from 40 to 75 pounds per square inch, and where the rivet has a high factor of safety, we believe the steam riveter is the most economical, as it can be built to be the most rapid worker. Many of the steam riveters are quite "savage" with the rivet, when working under quick motion, but that is because the valve gear is not built properly. The whole steam valve motion of a riveting machine should be more sensitive in action and adjustment than that of a steam hammer. High pressures, however, have, as the writer has often stated, "come to stay," and therefore 75 pounds steam pressure is now considered quite moderate. Pressures from 100 pounds to 160 pounds per square inch are commonly carried now in stationary, marine, and locomotive service, and the boilers to withstand these pressures must be beyond question as to design and method of construction. The plates now are mostly of steel, and vary in thickness from $\frac{5}{16}$ to $1\frac{1}{4}$ inches, while the rivets run from $\frac{9}{16}$ to $1\frac{1}{4}$ inches diameter. The increased loads to which these materials are subjected call for careful manipulation in every detail, and the metal must be free from sudden heavy blows or shocks, while passing through the several stages of manufacture. For the reasons just mentioned, the inventors of boiler tools have looked to hydraulics for a system best adapted to meet the requirements of the boiler makers, and they have found this old and reliable means of transmission of power an obedient servant. Pneumatic riveters of the most ingenious designs are now in use in the shops building large quantities of standard boiler work, and the result obtained by using these machines is highly satisfactory.

Punching and shearing machines adapted to large and heavy work are now driven by an engine directly attached to the main pinion shaft, the steam cylinder or cylinders being bolted to the main frame or housing of the machine. The power rolls are fitted with the most improved methods of removing a portion of the housings, to enable the quick removal of a small cylinder or flue from the rolls. Plate planers of enormous capacity and power, and with every needed adjustment for the tools and the work, are found in all modern shops.

Among all the large boiler tools now offered in the market by the well-known standard builders, it is certainly difficult in this age of improvements to see where any of them can be greatly improved in design or efficiency, though there is one machine that is yet far from being perfect in action, and the fault lies in one of its important motions. I speak of the power punch, and I hope I may not be understood as offering a general criticism on the many excellent power punching machines now being manufactured in various parts of the country. It is well known by all practical sheet and plate metal workers, that the chief work in punching any piece of metal is done in the initial part of the stroke. In punching a sheet $\frac{3}{8}$ of an inch thick, the heaviest part of the work is done in the first sixteenth of thickness, the labor on the machine in the last portion of the stroke being comparatively light. The motion universally used in power punches is the crank, either in pin or eccentric form, and with this motion the speed of the punch at the initial and completion of the stroke is exactly the same. I contend that this device for *this work* is wrong, and that it injures the material under treatment, to an unnecessary degree. If the punch was in all cases so arranged or adjusted relatively to the plate, that the initial cutting of the skin of the material was to begin when the crank was on the upward dead center, the injury would not be so great, as then the surface would be broken while the crank was on its slowest motion and most powerful position. In practice, however, the crank rarely, if ever, begins its work on the dead center, or even 10° off the center, but usually more than 20° from the dead center, so that when the punch is about one-third the way through the sheet or plate it has reached its greatest velocity, and it leaves its "ear-marks" at this point in an unmistakable manner. The motion required to do this work properly is a very simple one, and has its power divided and distributed on the stroke of the punch, to suit the resistance of the metal at the different points of the stroke. The initial breaking of the

outward scale of the metal should be so gradual that there would be little or no recoil to the punch and its attachments, and after this point in the stroke is passed, the speed of the punch should be gradually increased until it reaches something over four times its initial speed, at the finish. The writer has experimented in this line enough to satisfy him that, if this principle is adopted in heavy punching machinery, the production can be increased, and there will be no need of annealing iron and steel plates and bars after punching, in order to restore their original strength.

The arrangement of machine tools in a boiler shop depends on the class of work to be done. If the work is for locomotive service, the tools can be placed in compact form, but for stationary and marine boiler making, they will be necessarily in somewhat isolated positions, the erecting tools being at the erecting portion of the shop.

The handling of plates at the various machines should be done by power cranes and hydraulic lifts. The drilling and tapping machines should be portable, with self-acting feeds, and the forward and back motion arranged with power and hand gear. It is the opinion of the writer that the riveting of horizontal shell seams will soon be largely replaced by welding. This system has been in operation nearly two years in this country, and the welded joint has in repeated tests proved to be as strong as the solid sheet. Sheets 16 feet in length have been welded together for a boiler shell, thus producing a plain tube entirely free from rivets, except where the two heads were riveted to the shell at its ends.

Gas and petroleum will probably be the fuel for the boiler shop of the near future, for I think enough has already has been done in this direction to satisfy the skeptical, and "unbelievers."

The walls and roof of a boiler shop fitted with modern machinery should be strong and high enough to support cranes and traverses, although these will be light compared with those used in a machine shop or foundry, and, above all, put in a goodly number of windows.

The power for driving the boiler shop should be entirely independent of the machine shop, and for convenience in shipping there should be a railway track extending the whole length of the shop, and terminating at the yard derrick. The cost of making boilers has been enormously reduced within the past eight years; besides this, the same class of boilers are at least 20 per cent. stronger than they formerly were. While some of these benefits are due to the improvement in materials, the most of them have been realized by the vast improvement in the methods of construction.

In closing, I will say that experience and cold facts show that our boiler makers stand on the same ground with our engine builders. The careful, painstaking boiler maker will, in the long run, get the best class of custom and the most work, and there is no more room for a cheap boiler than there is for a cheap steam engine.

A San Francisco dispatch says: M. D. Babcock, inventor of the fire-extinguishing apparatus bearing his name, died at the almshouse Saturday, aged 70 years. Cause of death, softening of the brain. At one time he was in receipt of $10,000 a month for royalty on his machines, but after selling the patent rights the money was soon spent and for some years he wandered about the State in a destitute condition. About six years ago he was admitted to the almshouse, where he remained until his death.

Robert E. Masters, whom we recently noticed as about to leave his position in the Tredegar foundries, has been caned by the employes. The weapon used was gold-headed, and Mr. Masters carries it with him.

According to the *California Architect*, plank from redwood trees are sawed in that State from 10 to 11 feet in width.

Improved Car Wheel Borer.

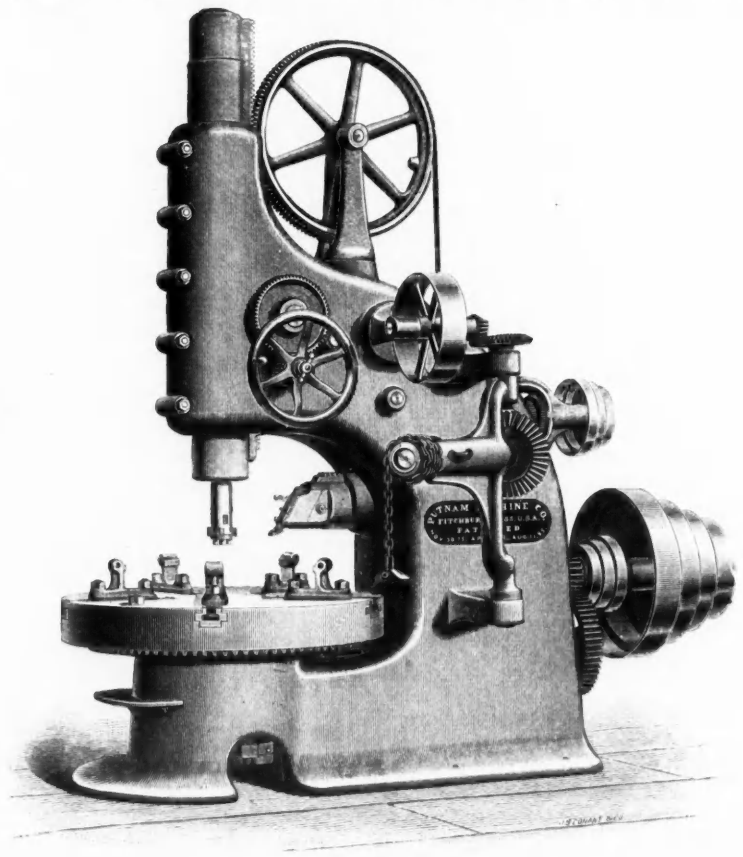
The accompanying engraving represents a car wheel borer recently brought out by the Putnam Machine Co., of Fitchburg, Mass. N. Y. office, 115 Liberty St. The design embraces new and desirable features which experience and thought have suggested.

The machine is fitted with power crane, automatic safety stop, and hub facing attachment. The chuck has five jaws arranged to be operated both universally and independently, and will receive wheels from 15 to 42 inches in diameter. It is claimed that wheels can be centered truer on this machine than on those of the ordinary pattern. The vertical pressure and end thrust of the cutter head is received on an anti-friction ball bearing of 40 hardened steel balls 1⅛ inch in diameter.

The chuck spindle is of improved construction, and runs in a babbitt-lined case, which provides for wear, and retains the precision of the chuck relatively to the boring spindle. The chuck spindle is hollow, which allows borings, chips, etc., to fall into a pit in the interior of the machine, whence they may be easily removed. The vertical boring spindle is large and easily operated, and is provided with take-up bolts, and has six changes of feed, ranging from $\frac{3}{16}$ to $\frac{3}{4}$ inch to one revolution of chuck. The spindle can be run up into the frame so as to clear the throat of the machine and give full play to the crane.

The boring spindle has an improved arrangement, which, after the cutters have passed through the wheel, stops the machine automatically, in case the operator fails to do so.

The hub facing spindle may be operated by hand, or it will advance and recede automatically, without any attention from the operator except to adjust the tool to its cut.



CAR WHEEL BORER

The machine will bore the holes of car or truck wheels either straight or tapering, as desired.

The driving cone has four changes for 5 inch belt, and by an improved arrangement the momentum of the motive parts may be checked by a friction brake on the countershaft, when the machine is stopped.

The power crane can be quickly and fully controlled by the operator, and will swing the heaviest wheels to the center of the chuck, and will also remove and lower them with rapidity. The machine weighs 18,500 lbs.

Each machine is furnished with countershafts, one patent cutter head, with a set of "Mushet" tools, cutter, gauge, wrenches, etc. The first of this pattern ever built has recently been placed in the shops of the Old Colony road at South Boston, and the second was shipped to the Boston and Albany R. R., East Albany, N. Y., and the manufacturers have three more under construction for other New England roads.

Mercury Plumb Bob.

This plumb bob is made of a solid steel rod, bored out and filled with mercury. The point is hardened, and the body and point are ground. It is nickel-plated and furnished with a braided silk line.

The length is 4", the diameter a little less than ½", and the weight 3½ ounces.

The instrument is unusually heavy in proportion to its size, and the center of gravity is low. Its shape and small diameter render it more convenient than the ordinary plumb bob. It can be carried in the vest pocket.

These plumb bobs are made by the Brown & Sharpe Manufacturing Company, Providence, R. I.

Emery Wheel Dresser for Use in Tool Post.

The engraving represents a modification of this well-known tool. As shown, it is made to use in the tool post of a lathe, and between the revolving toothed cutters steel disks of same temper of cutters are placed. It is said that for rough work these disks more than double the life of the cutters. The manufacturers are the Sterling Emery Wheel Co., West Sterling, Mass.

Mr. Lodge, of the firm of Lodge, Davis & Co., Cincinnati, devotes his time and attention to the management of the shops, and that he does this in a manner to win the confidence and esteem of the employed there is shown by the fact that on Christmas eve they surprised him by presenting to him a very elegant and complete silver service.

The Panama Canal project appears to be in a bad way, both financially and from an engineering point of view. It is doubtful if in this generation, at least, the canal will be completed. There is at this time better prospect for the Nicarauga canal, although operations on this have not been begun. The race is not always to the swift.

LETTERS FROM PRACTICAL MEN.

A Want.

Editor American Machinist:

Can any of your readers tell me of a process for blacking metals, a dead black being preferable? It is essential that the process should act on the metal itself, and be a part of it, and not be merely brushed on as a pigment. What I need is something in a liquid form that can be applied to limited portions with a brush or sponge, leaving other portions bright. It is needed for use on brass, copper, nickel, zinc, and possibly tin surfaces.

MEDICUS.

Engines for Steam Yacht.

Editor American Machinist:

Your correspondent O. W., Detroit, Mich., (Q. & A. 544), seems to be somewhat "rattled" on building a steam yacht. If he will go to New York and place himself in communication with any of the "Yacht Agencies" he can buy what he requires at one-third the cost of a new vessel, and all fitted up ready for work. He does not give the details of draught and speed required; which are very essential factors in answering his conundrums.

The wheel is given at 4 feet diameter and 6 feet pitch. This indicates a draught of about five feet, which is about an average, more steam yachts having less than more. Twelve knots an hour for a yacht of the dimensions indicated would be a fair speed, and would require an engine of 85 indicated horse-power and a boiler of 640 feet heating surface, and grate surface 4 per cent. of the heating surface, or 25 feet sq. feet. The engine, if of 12 in. stroke, would require to be driven 250 revolutions per minute to give the required power, or 500 feet per minute of piston speed.

The engine to develop this power, on boiler pressure of 100 pounds per square inch would, if a compound and cut-off at 6 inches of the stroke, or say 7 inches, be 7 inches high pressure, 15 inches low pressure by 12 inches stroke, with a surface or outboard condenser, air pump, etc.

It would have to be a very carefully designed single crank engine to bear 250 revolutions per minute without undue vibration and straining of the engine. The better plan would be a vertical compound, cranks at right angles and counterbalanced.

The blower for so small an engine would be a nuisance. The better plan would be a simple coil, or ventilator pipe, carried three or four times across the up-take in base of the funnel, and then into the closed ash pit, or about the fire, as required, thus feeding the fire with waste heat from the boiler furnace.

Your advice to employ a competent engineer is eminently sound.

STEAM YACHT.

San Francisco, Cal.

Oil in Boilers—Graphite Packing.

Editor American Machinist:

The paper on "The Use of Kerosene Oil in Steam Boilers and on Graphite Pipe Joints," written by Mr. Lewis F. Lyne, M. E., Jersey City, and read before the American Society of Mechanical Engineers at Philadelphia, has already been published in your paper. It has been submitted to a friend of mine, one of the best steam engineers in the State of New Jersey, and he writes as follows:

"I return the paper on 'The Use of Kerosene Oil in Steam Boilers and on Graphite Pipe Joints,' and thank you for the privilege of reading it. I have heretofore used petroleum, and not kerosene oil, but would have used kerosene in absence of crude petroleum. Hereafter, however, I shall use kerosene, as I can endorse the fact recorded in the paper, that if crude petroleum is not used with discretion it will, in muddy water, form a paste and work injury to the boiler.

"I have long used an apparatus on my feed pipes to introduce the petroleum to the

boiler under pressure, simply because of greater convenience, and I do not find that my feed pipes ever contain a deposit of any kind. Furthermore I never have to do anything except to wash out the boiler while it is cold. I am glad to know that my own experience has been demonstrated so clearly by the experiments described in Mr. Lyne's paper."

Concerning packing he writes:

"I do not quite agree with Mr. Lyne, that asbestos packing is the best. I have for years used *pure graphite* and I have never had a leaky joint. I have joints made in 1882, and they have never leaked and will never leak. My method is to use five pounds of rubber and 10 pounds of 'Perfect' graphite mixed together. I roll it out $\frac{1}{8}$ inch thick and cut my packing to the required shape and screw down hot; that is, I follow it with a wrench as the boiler, etc., get hot. I do not know whether this method is more expensive or not; I use it because I have both the rubber and the mixing mill at hand.

JOHN A. WALKER.

Brass Foundry Matters.

Editor American Machinist:

I was much interested in your article in regard to the association of foundry foremen.

Foundry art and literature (especially brass foundry) have been sadly neglected, and to none is this more apparent than to the person that is looking for it.

There are, to be sure, some works on brass founding that can be used for reference, but nearly always when you get a difficult job to tackle they fail to give the desired information.

I have studied several so-called founders' guides and assistants, and, beyond a few general instructions have never been able to get much practical assistance from them. But on the other hand I have derived a great deal of information from the articles in the AMERICAN MACHINIST, especially those by R. E. Masters. But they have been mainly on the subject of heavy iron casting and of course, not being in my line, did not impart the information desired.

There are in this country quite a number of brass foundries engaged in the production of builders' hardware, and it has been my lot to work in quite a number of them. I have yet to find that (with one single exception) the parties in charge of those foundries ever pretended to make any study of the properties of metals, or the most economical method of mixing and melting them. In some of those foundries the foremen were not even moulders themselves, and yet the company that employed them was always wondering why it was that their work was not as good as others. I know of one that was in charge of one of the largest concerns of its kind in the country, who, happening to see some work that one of his men had dumped quite hot, and on exposure to the air it had turned black, said in all seriousness: "I guess you must have put too much charcoal on your moulds."

It has also been my experience to find that moulders generally are very much in the habit of taking for granted what may be told them by others, without once suspecting that they might possibly be wrong. I have been a constant reader of the AMERICAN MACHINIST for five years, and never adopted any of its suggestions until I had fully satisfied myself that they were correct, and in some instances I found myself practicing improvements on those suggested. Most moulders are apt to think they know all about it, and that their way is the only one, and it is a hard matter to get them to adopt a new idea. A case in point came under my observation not long since. In trying to devise means to get better castings, I found that I could improve the work by not cutting a riser from the top castings in the flask, as it only made an outlet for all the gas generated to whistle through. I had occasion to give this work to one of my men, and told him of my experience, and that I would like him to try the same. Instead of doing what I told him, he took the advice of the next man to him, and went ahead the old way. When I asked for an explanation he said that so and so did not think it would work. Of course I had to inform him that things had to be done the way I wanted, no matter what the other man thought. The next week there was an article in the AMERICAN MACHINIST sustaining my point exactly, and I showed it to the moulder in question. A short time after they were talking it over among themselves, and I had the pleasure of hearing the other man say, in reference to me: "What does he know anyway, only just as he reads it in books?" And yet this man could neither read nor write his own name. I give this as an illustration to show how little foundry literature is looked for, and I find the same to be the case in regard to those working for me at present. I have eight apprentices, and I do my best to encourage the habit of reading amongst them, feeling that by so doing I would get just as much benefit myself as they. But there is only one that shows anything like the interest that I would like to see in that respect, and he is to-day so far advanced ahead of the others that they can never hope to catch up; and yet they feel jealous, and seem to think I accord him favors which I deny to them.

SLOTTED DRILL REST.

I would like very much if the association of foundry foremen was extended outside of New England, so that I might be able to take advantage of it, in the hope that it might be instrumental in awakening an interest in the foundry, and placing it where it rightfully belongs.

RICHARD M. WHITTAKER.

That Slotted Drill Rest.

Editor American Machinist:

Under date of December 31, Frank H. Richards says of the solid slotted drill rest:

"If the lathe carriage is not of the tilting kind, or has not some ready device to raise and lower the tool post, it is difficult to set the solid slot just right, and, as usually happens in such cases, pretty near is good enough." We have no difficulty whatever in attaining the proper height with our "solid slot." It is probably not fashioned after the Richards pattern, but is something like the sketch. The slot should be 1½ or 2 times as long as the drill shank is wide. It will now be clearly seen how a fine adjustment for height can be made by moving the tool block a fraction of an inch toward or from the center of the lathe.

J. E. MCCONNELL.

Ice in a Steam Pipe.

Editor American Machinist:

I have had an interesting question suggested to me lately by some experience with steam heating apparatus, and I would like to call out some experience on the same point.

Suppose a pipe to be taken off from a boiler and run 200 feet underground to heat a large room. Suppose the pipe becomes frozen during a shut-down, so that about a foot of it is filled solid with ice. Now if steam at 90 pounds pressure be turned on, what will be the result? Will it melt through, and, if so, how rapidly? How would low pressure pressure steam behave?

I have put the question in the particular form in which it occurred to me. Circumstances will differ, of course, but I would like to know if any one has had experience in this direction. I think it will be interesting.

J. TORREY.

Slotting Machine Bar.

Editor American Machinist

I have sent to you a drawing of a slotting machine bar as made by me. In the drawing the bar is marked *C*; its lower end is formed so as to allow a rectangular slot to be cut through it. In this slot is placed the tool holder *F*, which works on the pivot *B*. In this holder the tool *A* is secured by means of the set screws *E E*, the heads of which project into the slot *D* cut in the end of the bar *C*. The object of this design of slotting machine bar—as will be readily seen—is to relieve the tool *A* of the pressure against the work on its return or upward motion, which is accomplished by the tool holder *A* rotating slightly around the pivot *B* at the commencement of the upward stroke, and when completed the tool is at once pressed into its correct position for cutting by the spring *G* and holding it in readiness for the downward movement of the bar. Similar letters in the different views represent the same piece of mechanism, otherwise I believe a further description is unnecessary, as the drawing will explain itself.

A. S. BERGH.

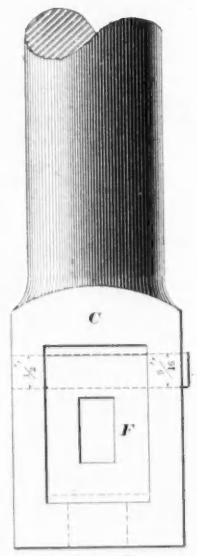


Fig. 1.

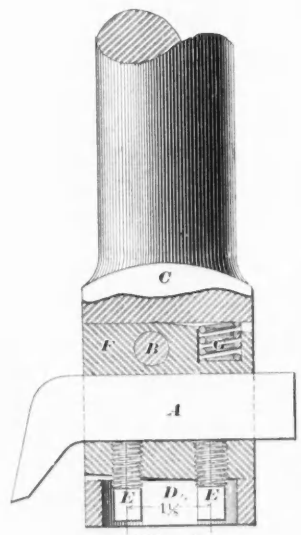


Fig. 2.

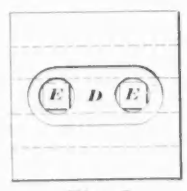


Fig. 3.

SLOTTING MACHINE BAR.

Annual Report of the Chief of the Bureau of Steam Engineering.

We have received, through the courtesy of Geo. W. Melville, Chief of the Bureau of Steam Engineering, Navy Department, a copy of his annual report for the year 1887.

In addition to the usual account of work done, expenditures, estimates, etc., the report contains much pertinent comment, opinion and recommendation.

Engineer Melville is of the opinion that the number of engineer officers in the service is entirely inadequate, and the number is, by provision of Congress, rapidly decreasing. When the contemplated reduction is complete there will be but 170, and many of these must attend to shore duty, while the class of vessels now building, owing to complicated machinery, will require the services of more engineers than any vessels now in service. He thinks the reduction should be stopped at once, and we think in this he is quite right. The utility of the kind of vessels likely to be in service in the future will more than ever before depend upon the qualifications of the engineer corps, and in an emergency, engineers cannot be enlisted and properly qualified to look after the machinery in a few days.

Attention is called in the following to what is perhaps a mild form of large headedness, and the love of showing authority:

"I would call attention to the various ways in which commanding officers interpret the duties of engineers on board ship. Some very rightly leave the arrangement of watches and the distribution of duties to the chief engineer, holding the latter strictly responsible for the faithful performance of the duties of his subordinates and for the efficient working of the machinery. Many commanding officers, however, arrange these details to suit themselves, often requiring the engineers to stand regular watches in the engine room at all times, day and night, whether there is anything to demand their attention or not.

"Standing a watch, as does the officer of the deck, with duties pertaining to military routine to perform, is one thing, and standing watch, as engineers are frequently required to do, over a mass of cold cast-iron, is quite another. The latter is neither inspiriting nor healthful to the victim. The arrangement of these details should be left to the department, commanding officers being allowed to change them only in case of emergency. The number of engineers sent to each ship should be arranged according to the importance and complication of the machinery, and nobody is more competent to judge of this than the bureau of steam engineering. Where the number of engineers is sufficient, they should be required to stand watch, but, when under steam, on the main engines only. No engineer should be required to stand a watch except when there are duties to perform which demand an engineer's constant attention. The idea that an officer is not doing his full share of duty when he is not as uncomfortable as it is possible to make him is too prevalent in the service. It will be found that engineers will take more interest in their duties and perform them much more satisfactorily when they are not required to perform imaginary duties for which no necessity exists. * *

"Not very long ago, on board a ship which is full of machinery, the chief engineer complained that he was unable to do the necessary overhauling and repairs, as he was not allowed the use of his men. The reply of the commanding officer was that the presence of the men at the drills could not be dispensed with, and that if repairs to the engines were necessary they could be done at night. The result of such action is inefficiency of the motive power and unduly rapid deterioration of the boilers and machinery. The average life of our boilers is less than it should be, and many of our engines, although originally economical, have become wasteful of fuel simply from want of attention, while the labor which should be used on them is diverted into other channels. This must all be changed, and changed quickly, if our vessels are to be kept in effective condition. The department enlists men for the engineer's force for the purpose of manipulating and taking care of the machinery, and they should not be employed for other purposes while this work remains undone. None of these men should be employed in any work other than that for which they were intended, without the previous statement of the engineer in charge that his department is in such a state that their services can be spared; this statement to be recorded in the steam log book. The coal heavers should be considered as a permanent part of the engineer's force, as was intended when the rating of coal heaver was established."

It is, according to the report, impossible to get as good a class of machinists and other artificers as is desirable. The pay, it is concluded, should be greater in some cases, but the chief trouble is, to do away with the cautious language employed by Engineer Melville, because they are not decently used. He thinks this should be remedied, as the services of good men are necessary.

Some hard blows are struck—in a dignified way—at the senseless red tape of some of the naval departments. The navy yards are replete with absurd arrangements, and "there is too much of the military principle at our yards to enable them as manufacturing concerns to carry on their business with proper economy or dispatch."

Altogether, the Chief Engineer's report is interesting reading, and we regret that we cannot give space to more of the interesting and valuable suggestions it contains.

The land tenure, the telegraph and the protection of the surplus earnings of the frugal of small means are leading questions now before the country, and our representatives are called upon to formulate and put in force the sentiment of the people as it may find expression.—*The Jeweler's Journal.*

English Boiler Inspection.

BY W. H. BOOTH.

FOURTH PAPER.

It will naturally be supposed that in the course of many years of inspection the furnaces of a steam boiler have been found a weak part. Insurance companies are called upon to make furnace defects good more frequently than anything else. Owing to the severe punishment to which the plates of a boiler are put which are exposed to the direct action of fire, it is generally conceded that plates exposed to fire should not form a portion of the outer shell if they should not be in tension. Hence the externally fired boiler is very little used, excepting at collieries where the use of rubbish as fuel necessitates a large grate surface not attainable in an internally fired boiler of the Lancashire or Cornish type. When, however, the plain cylindrical boiler is employed it is usual, in the best practice, to make the first plate—that immediately over the fire—of great length, so as to avoid the necessity of having a seam of rivets exposed to flame. When this is the case, and the plates are anything over $\frac{3}{8}$" thick, there is every probability that the seam will become overheated, and fractures will occur which are liable to extend into the body of the plate beyond the rivet holes, and so bring about an explosion. Lancashire boilers are rarely found set with the external furnace. The writer, however, knows several instances of this mode of setting being employed, notably in Yorkshire, where a high regard is had for the revolving furnace. This furnace device works best with a wide grate, and so is often placed beneath the boiler and is productive of danger, and necessitates frequent renewal of the first bottom plate, especially when the water is at all of a scaling nature. Speaking generally, then, it may be said that inspection has led to a preference for internal firing, though doubts may be thrown on the economy of this method, it being quite probable that a better combustion may be obtained with external fires, owing to the ease with which the furnace width and height may be chosen at will to suit the fuel and draught and other conditions. As before stated, furnace faults are numerous, and the danger to which the internal furnace is more particularly exposed, is that of low water and consequent overheating of the plates, which, losing their rigidity, collapse under the pressure, and often a furnace is almost flattened, sometimes taking quite grotesque shapes that would hardly be thought possible. When inferior material has been used, such deformation rarely takes place without a tear in the plate, and through the opening thus formed a mingled torrent of steam and water is violently ejected, sweeping the fires from the grates and hurling these with the grate bars and fire-doors out at the furnace mouth like the discharge of a cannon. This liability to tear has brought about the utmost care in selecting suitable material for furnaces, hence the use of Lowmoor plate for the crowns. Now, however, furnaces are almost invariably made from mild steel of from 26 to 33 tons tensile strength, and capable of enduring almost unlimited punishment. So constructed, a furnace crown may come down without causing further mischief.

For many years furnace tubes of Lancashire boilers were built up of conical rings, simply lap-jointed and telescoped together, or of parallel rings of plate alternating in and out. Fairbairn, who founded the Manchester Steam Users Association in 1854, experimented largely on tubes to ascertain their resistance to collapse. He found, of course, that a lap-jointed tube was weaker than one made perfectly circular in cross-section, and he found also that long tubes collapsed more readily than short ones, owing, doubtless, to the support of the end plates being less effectual than with shorter tubes. He found further that the encircling of a tube with one or more hoops at intervals of a few feet gave practically a strength to a long tube equal to that of a short tube of a length equal to the distance between the hoops. This opened up a wide field in construction boiler work, and rendered higher pressures possible. It also rendered possible the continuance of thin plates, for as with outside furnaces it is equally true of internally fired tubes, that when plates of over $\frac{3}{8}$ thick are united by rivets as an ordinary lap joint, there is a great risk of overheating taking place at the seam. Thus $\frac{7}{16}$ became a quite common limit of thickness, and when plates of half an inch were em-

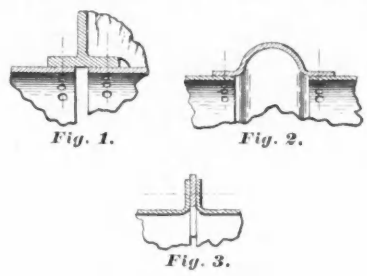


Fig. 1. *Fig. 2.* *Fig. 3.*

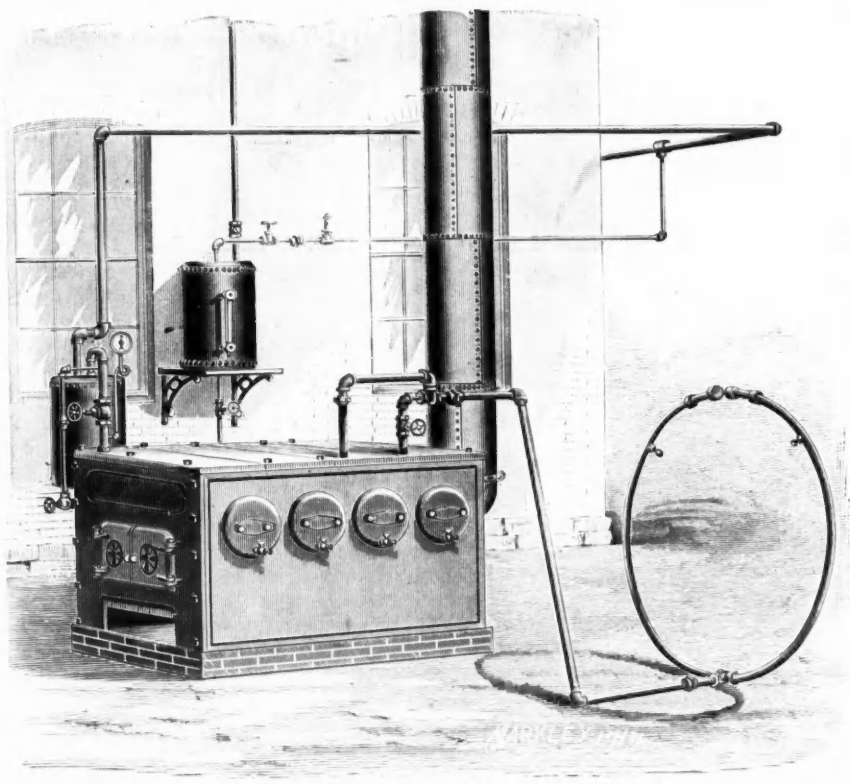
BOILER INSPECTION.

ployed they almost invariably became burnt at the overlap on the fireside. The discovery of the effect of stiffening rings led to furnace seams being constructed of the forms shown in Figs. 1, 2, and 3. Fig. 1, the tee iron seam, is a good strong form, but having rivets exposed to the fire and double plate thickness, is liable to overheat at the overlaps of the plates. It also exposes one overlap edge against the direction of the flames. It has, however, a further fault: it is liable to become notched down from the edge of the vertical web to the base. This peculiar action or disintegration, though hastened by corrosive action of the water, is due to a mechanical action. The joint generally gets hot and expands; the thin vertical web is completely surrounded by water, and therefore much less hot than the body of the ring, and does not expand equally. Something has to give way, and this something is the extreme edge of the T web, which opens out in minute cracks; these extend under the oxydizing action of the water, as shown in the Fig. 1.

Fig. 2. The Bowling iron hoop exists also in an almost similar shape in steel as the Bolton hoop. It has the same faults as the T seam as regards overheating, but avoids the web action of the latter, and is generally a good seam, quite largely used even now. It was first introduced as a means of providing longitudinal elasticity in the tubes, but it is doubtful if it affords any. Both the foregoing joints give way before Fig. 3, the Adamson flanged seam, invented by Daniel Adamson, of Manchester ship canal fame. In this seam, which is formed by outflanging the ends of each ring of plates, to be connected, and uniting them by rivets passing through the plates, and an intermediate strengthening ring, as shown in our sketch, there is nowhere a double thickness of plate exposed to the action of the fire, and the rivets are entirely in water. This seam, indeed, appears to be as perfect as can be designed, and though claimed as difficult of repair, owing to the fact that its large diameter forbids its insertion at the front end plate furnace openings, and requires the end plate or boiler head to be removed if a seam has to be removed, still many repairs are not needed, and this seam is certainly the best, as shown by its almost universal adoption, and the opinion of inspectors. The necessity of strengthening the furnace tubes of old boilers, to allow of higher pressures being employed, has led to various forms of stiffening rings, notice of which I must defer to a future paper.

Apparatus for Heating, Setting and Removing Locomotive Tires.

In our issue of May 21, 1887, we illustrated and described quite fully this device in a portable form, as made by Pedrick & Ayer, Philadelphia, Pa. In this issue we show the device as arranged permanently. With this apparatus the heating is done by gas made by the apparatus itself, burned at perforations in the hoop shown, which encircles the tire. We refer those who desire a more detailed description to the number of the AMERICAN MACHINIST referred to above. Since our previous illustration the apparatus has, in both its stationary and portable form, come into quite extended use. As a matter of general interest we append the following report of tests made in running and setting tires:



APPARATUS FOR HEATING, SETTING AND REMOVING LOCOMOTIVE TIRES.

REPORT OF TESTS MADE WITH APPARATUS FOR HEATING, SETTING AND REMOVING TIRES AT WEST PHILADELPHIA SHOPS OF PENNSYLVANIA R. R. CO.:

"On Sept. 22, 1887, six (6) 48" tires were taken off in from 5 to 7 minutes each.

"On Sept. 26th, six (6) new 48" tires 3" thick, with standard Pennsylvania R. R. shrinkage, were put on in from 12 to 18 minutes each.

"In the above tests a burning hoop $1\frac{1}{4}$" diameter with $\frac{1}{8}$" holes, drilled $1\frac{3}{4}$" apart, was used.

"On Oct. 20, took off 4 68" tires, averaging 15 minutes to a tire—the burning hoop was made of 1" pipe, with $\frac{1}{8}$" holes, drilled $1\frac{1}{2}$" apart—in all the above tests the air pressure was from 8 to 15 lbs., and no storage reservoir was used for the air. An 8" pump was used, located about 250 feet from the generator. A storage reservoir was deemed necessary for a strong and even pressure of air on the gas, and one was attached prior to the test made.

"On Nov. 24, when 2 48" tires, of Lehigh Valley R. R. Co. were taken off, a burning hoop of $\frac{3}{4}$" pipe, with $\frac{5}{32}$" holes drilled $1\frac{3}{4}$" apart, was used; these tires were 3" thick and had $\frac{1}{16}$" shrinkage; they were taken off in 30 minutes each. Two (2) 44" tires of Pennsylvania R. R. Co., with standard shrinkage, were taken off in $4\frac{1}{2}$ minutes each. Next came a pair of 54" tires of Lehigh Valley R. R. Co.; these they had tried in every conceivable way to take off themselves, but without success; the tires were rusted to the wheel centers, and these centers were both cracked in their hub around the axle. As the tire expanded the cracked center also expanded; this might have been carried on indefinitely without any result other than the opening of the cracked wheel center; this center was, however, cooled with hose, when the tire came off easily; the second, although cracked worse than the first, came off in 40 minutes. The tires taken off these broken centers were measured while hot, and again after they were cool the day following. They had expanded a full $\frac{1}{4}$"; the tire was not round; the largest way was $\frac{1}{2}$" larger than when cold, and the smallest diameter was $\frac{1}{4}$" larger than when cold. This variation in the diameter was caused by the fracture in the hub, without an equal expansion of the centers. This test was made in the presence of Master Mechanics Kinsey, Mitchell, Clark, Hofecker and Campbell, of the Lehigh Valley R. R. Co., and Mr. Garrett, Master Mechanic of the Pennsylvania R. R. Co. The storage reservoir for air gave a steady and reliable pressure of air throughout. The flame was an intense blue one, showing that combustion was perfect. The quantity of oil used averaged from half a gallon to three quarts to a tire, a gallon of oil being used up in about 13 minutes. These tests were all made in the open air, and at times in face of a strong wind, which blew the flame from the tire, causing it to work to a disadvantage as regards length of time required for each tire."

A fusible plug, or more properly a fusible ring, is in use in steam boilers in England. This ring is inserted in the end of the plug, which enters the boiler quite a distance, and into the ring is driven a second gun metal plug. This encloses the ring between two gun metal surfaces, exposed to the heat. We should assume that the ring being protected from the water, except at the end, and being between two good conductors, would be less likely to fail to melt when occasion required.

The Apprentices Exhibition in London, which we have previously noticed, appears to have been a success. Apprentices of from one to three years' standing exhibited model engines, lathes, dynamos, small tools, etc. It is very generally believed that the exhibition is a success, so far as encouraging apprentices to better effort is concerned.

An English invention relates to set-squares for draftsmen, having one of the edges beveled at various angles. It is just the kind of set-square that a draftsman in this country would relegate to his department of curiosities.

The drift of popular opinion is, that the coming railroad passenger train will be heated by steam from the locomotive, either live or exhaust steam. We incline to the opinion that exhaust steam will be used.

The use of steel castings is becoming so extended in England as to alarm the iron-founders, who see their prospects for work slipping away from them.

The *Locomotive* has an account of the explosion of nine saw-mill boilers in October 1877, and only one boiler of a locomotive.

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Opportunities of the Small Manufacturer.

It is doubtless true that the enormous concentration of capital that characterizes nearly every operation of the present day makes it more difficult for the individual of limited means to engage in business for himself, but in most kinds of legitimate business it is by no means so difficult as it is assumed to be. In manufacturing, for example, notwithstanding the tendency to concentration, the greater part of the business of the country has come up and will continue to come up from small beginnings. This is particularly true of the machine business, and allied industries. The large machine shops of to-day were the small ones of a few years ago, and there appears to be proportionately just as many small ones as ever there were, going through the process of growing up. The letters from manufacturers which we publish each year tell the story in this respect. The majority of them speak of enlargement of works or added facilities. And this has been going on from year to year, and every year small shops are added to the list, the fittest of which will tell the same story of growth. It requires more knowledge at the present time to start in a small way in the machine business and work up successfully than it did thirty years ago, but there is more knowledge in these matters now than then.

The machine business is probably better adapted to this process of growing up than most other manufacturing enterprises. There is less limit to the skill and tact that can be profitably employed in a small business. And when men of recognized abilities as mechanics start in the machine business, a knowledge of the fact that they can give personal attention to everything, is very likely to bring them work, and the gradual expansion from the small to the large shop begins. Growth of this kind is healthy, and the large works growing up from such beginning are likely to be well appointed and looked after.

Many small shops started by men of ability get very material help from large ones Work is wanted from the large shop that the manager does not care to undertake, but he likes to send a customer where his work will be well done. There is a good deal of courtesy of this kind extended.

So far, then, as the machine business is concerned, it does not seem likely that the movement towards centralization will seriously affect those who want to start in a modest way. And we think the same is true of a good many other kinds of manufacturing, but to succeed from small beginning requires more tact than formerly, and harder effort. If "trusts" become the order in machinery, then the chances of the small manufacturer will be nearly hopeless: the crushing-out process to which monopolies of this kind resort will leave him hopeless. But we do not believe this will be the case. There is too much independence amongst machinery manufacturers, to be satisfied with the restraints of the modern trust. It does not suit the kind of intelligence that is engaged in the machine business of the country.

A Case of Recklessness.

During the investigation of the causes leading to a recent serious collision which took place on the Northeastern Railway, England, the fact was developed that the engineer of one train had been on duty 17½ hours on the day preceding the accident, and after a rest of only 7¼ hours had again come on duty, had at the time of the accident been on duty nearly 13½ hours, and, had the accident not prevented, would have been on duty about three hours more. This makes 31 hours duty, and 7¼ hours rest out of 38¼ consecutive hours, assuming that he was so situated that the whole of the 7¼ hours was available for rest, which is not probable. The engineer of the other train had been on duty nearly 14 hours, and had it not been for the collision would have been on 18 hours.

Such hours of service for men upon whose shoulders rest such responsibilites, who must exercise such constant and unrelaxing vigilance as is required of railroad engineers, is against nature, and should by no means be tolerated.

If a railroad company allows its rolling stock to become run down and worn out to such an extent as to be unsafe, and such conditions result in accidents causing loss of life, the company is justly held responsible. Are they really any less responsible for disasters which may occur as a result of the wearing out of employes upon whom responsibilities rest, by hours of duty of such length as to be a violation of the laws of nature?

There are no moments of relaxation for a railroad engineer while on duty; every faculty must be constantly employed, and no man can endure such hours without sooner or later breaking down, with the probable result of a serious accident.

In the interest of the men, the companies, and the traveling public, no such hours should be tolerated.

In one of the letters from manufacturers which recently appeared in the AMERICAN MACHINIST is this passage:

We have to note a slight advance in wages during the year, but with improved methods it does not appear that our engines cost us any more than previously, nor have we been able to get any better prices than heretofore.

There is, perhaps, a chance to read between the lines here. No doubt the company from which this letter came have improved their methods; they are well known as being progressive in this respect. But is it not possible that the incentive of better wages has induced that good feeling on the part of the workmen that brings about increased production?

The newspapers in some parts of the country are lending themselves to the work of making out a lack of mechanics and laborers in those sections, and so securing immigration from other parts of the country to fill the assumed want. In the majority of instances, mechanics who scrape together just enough money to get there, find nothing to do and their prospects materially worse in every way than in the places they left. It is despicable business on the part of the press. Our advice to mechanics is: pay but little attention to anything you read in the papers about plenty of work and high wages in some other part of the country.

As an evidence of the difference between honest and "scamped" work, we remember an instance where a manufacturer was furnishing a certain class of work in which the weight had been carefully cut down to what was believed to be right for the purpose. Finding himself undersold, he investigated the matter and found out that the castings (they were of bronze) for his work actually cost him more than the finished product of his competitor was sold for.

Machinery manufacturers in this country are recognized as an intelligent part of the citizenship of the country: similarly, mechanics working at the trades connected with building machinery are recognized as men of high intelligence. Put this and that together, and there is reason for the almost entire absence of serious labor troubles in this industry.

The AMERICAN MACHINIST has, during the past six years, endeavored to show that the use of crude oil for steam making could not compete with coal economically, except in rare cases, unless prices were changed materially. It has always, so far, been an elementary question in arithmetic, about which there ought to have been no trouble.

The first instance of the holding of a regular meeting of an English scientific society in this country will occur next fall, when the Council of the Iron and Steel Institute of England will meet here, probably in December. They come upon the invitation of American iron and steel manufacturers. Two hundred and fifty members, including some of the most prominent manufacturers and scientists of England, Germany, Westphalia, Sweden, Italy, and Spain, have promised to attend the meeting.

Literary Notes.

The Locomotive Engineer is the name of a new monthly journal, published at 96 Fulton street, New York. It is "devoted to the special interests of locomotive engineers and firemen, and to locomotive maintenance and repairs." The belief of the publishers is that the men to whom the paper addresses itself will be interested in a journal devoted especially, and in a popular way, to locomotive operation, and to the roundhouse and repair shop; hence, *The Locomotive Engineer* will, in a sense, seek a new though a wide field. The editor, John A. Hill, is a practical railroad man, who stepped from the footboard to his present position. He is known to the readers of the AMERICAN MACHINIST, through having contributed to its columns various articles upon practical railroad matters, that brought out much favorable comment. The aim of the publishers and editor is to make *The Locomotive Engineer* an original, spicy and instructive paper; judging from the first number, it is likely to be welcomed from the start. The subscription price is $1 a year.

DIRECTORY TO THE IRON AND STEEL WORKS OF THE UNITED STATES. Embracing a complete list of the Blast Furnaces, Rolling Mills, Steel Works, Forges and Blomaries in every State and Territory; also Wire Mills, Wire Nail Works, Car Axle Works, Car Wheel Works, Car Builders, Locomotive Works, Wrought-Iron Pipe Works and Cast-Iron Pipe Works. Prepared and published by the American Iron and Steel Association, 261 South Fourth street, Philadelphia, Pa. Price, $3.00.

This is a work of 243 pages, and the information it contains is valuable to every one interested in iron and steel manufacture. Its compilation requires a large amount of careful labor. It is corrected down to Nov., 1887. It is well indexed for convenient reference.

We have received the December number of the *Transactions of the American Institute of Electrical Engineers*. In addition to the transactions of the institute, it contains an index of current electrical literature, which will undoubtedly be appreciated by those interested in such subjects. It is published at 16 Dey street, monthly, at $5.00 per year.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(26) L. A. W., Fernandina, Fla., asks: Will you please let me know how many gallons of water per minute will flow out of an artesian well, 575 feet deep, pipe 8 inches in diameter, and gauge pressure 15 pounds per square inch? Also give rule. *A.*—About 5,300 gallons per minute. For rule see any good engineer's pocket-book. John C. Trautwine's Civil Engineer's Pocket Book is very complete on this subject.

(27) J. A. J., Anniston, Ala., writes: 1. Please inform me how to braze, and if there are more ways than one, please give them. *A.*—Brazing is the art of uniting the surfaces of metals by partial fusion, and the insertion of an alloy between the edges In order to join metals it is obvious that an alloy must be used that melts at a lower temperature than the metal to be joined, and it may also be necessary that the alloy approach as nearly as possible to the metals in point of hardness, and occasionally similarity of color is an object. When two articles are to be united by brazing, they must be perfectly clean, bound, fluxed and spelter ed, and the whole subjected to a clear charcoal or coke fire, in a furnace or forge, as the case may require. Different alloys are used, depending on the metals to be brazed; the time of exposure of the metals to the heat also depends on the kind of work, and in fact the whole manner of brazing depends upon the alloys used, and the

kind and form of articles to be united. To explain the whole subject thoroughly would require too much space in these columns. If you wish to learn every branch of this business, we should advise you to go in the shop, and learn them by actual practice. 2. How much inside lap has a Baldwin locomotive? *A.*—That depends on the kind of service the engine has to perform, and the kind of road it has to run on. In some cases, inside lap is given, in others, the inside lap is avoided. The amount of inside lap also varies to suit given conditions.

(28) **F. T. W., Owen Sound, Ont., asks:** Will you inform me as to the operation of making a plumber's wiped joint? *A.*—See Question and Answer 263, AMERICAN MACHINIST, June 28, 1884.

(29) **C. H. L., Canton, Maine, asks:** What should be the speed of a grindstone 4 inches by 40 inches diameter, 2¼ inches shaft, with 10 inch collar on each side? *A.*—A good speed for such a grindstone, for grinding tools, would be about 75 revolutions per minute.

(30) **J. S. P., Woodstock, Ont., asks:** 1. What are the best books on mechanical drawing? *A.*—We know of no work equal to the series of articles now appearing in the AMERICAN MACHINIST on this subject. These articles will be made complete, and will comprise the whole subject. 2. What is the throw of an eccentric? *A.*—As we call it, it is twice the distance between the center of the eccentric and the center of the shaft. This is according to the definition given by Webster. See AMERICAN MACHINIST of Sept. 26, 1885.

(31) **W. M. H., Cleveland, O., writes:** Will you please inform me if the U. S. Government requires something more positive to cancel postage stamps than the present method or not. Also whether postage stamps are counterfeited to any extent or not. I have an idea of a positive way to cancel these stamps, and am anxious to know if it is wanted. *A.*—We have not heard of any objections to the present method of canceling postage stamps. But if you have any method much better than the present one, we should advise you to lay your ideas before the Postmaster-General. As for counterfeiting postage stamps, such seldom occurs, but we are told that many are washed.

(32) **M. S., New York, writes:** I am a graduate of the Russian Technical Railway School, and have had long experience in railway shops and on the engine in that country. Here I am engaged in some machine shop as a machinist for a year already. I am determined to become a railroad engineer. Would you give me full informations of all the ways and means necessary for me to become an engineer. *A.*—In this country the ways and means necessary to rise in any profession are a good sound education which will fit the person for those positions which he seeks to fill. In addition to this he must be strictly honest, and full of life and energy, not allowing an opportunity to pass which he can honestly take advantage of to assist him in promotion in his profession. If you have a thorough education which will fit you for a railroad engineer, seek to obtain a position on a railroad, and then do your duty as a man in every sense of the word. Your second question we do not understand.

(33) **C. E. B., Philadelphia, Pa., writes:** If A, as my draftsman, and under my pay, designs certain mechanical apparatus, which I patent in his name, and manufacture as a staple article, can he claim royalty of me or prohibit me from manufacturing the goods after he leaves my employ? Again, if, under a misapprehension, I should agree to pay him a royalty, would I be bound by such an agreement, if I found I was mistaken in the premises, and that a royalty would have been unnecessary? *A.*—If the patent is in the name of your draftsman, without assignment to you, either in the patent or afterwards, he can hold everything that the patent entitles anybody to. Because a man sells his services as a draftsman to you, it does not follow that he sells all his future prospects. When a man secures a patent in his own name, without assignment, nothing but some future action on his part can deprive him of the advantages of it. This answers both your questions.

(34) **C. E. C., Fort Wayne, Ind., writes:** 1. Please give me your opinion on the following: A customer wants a flue boiler, having three flues in the upper row, the diameter of the center flue being 15 inches, and the diameters of the flues on each side of it being 10 inches. In the lower row there are to be two flues, each 10 inches in diameter with a manhole between the two. Now will this lay-out make a good steamer? Will each flue draw equally, or will the large flue draw the heat and flame away from the smaller ones? The boiler will be 52" x 24'. *A.*—It seems to us that the large flue may draw some of the heat away from the smaller ones, yet not sufficient to cause very bad effects. We would advise to make the upper flues equal in diameter. 2. Please give formula for getting the proper size of a lever to sustain a given weight or force. *A.*—In books relating to the strength of material it is proved that the strength of rectangular beams varies in the same proportions as their breadths, that is to say, if it requires 4 tons to break a beam 4 inches wide, it will take 5 tons to break a beam 5 inches wide, or 6 tons to break a beam 6 inches wide, leaving the other dimensions the same in all the beams. If the beams are exactly alike in all dimensions except the depth, then their strength will vary directly as the squares of their depths. Thus: if we have three beams, which are 4, 5, and 6 inches deep, but alike in all other respects, then the ratio of the weights which will break these beams will be as the squares of 4, 5 and 6 that is, as 16, 25 and 36. Again, if all the dimensions of the beam remain the same excepting the length, then the strength of the beam will vary inversely as those lengths, that is, if one beam is twice as long as another the strength of the latter will be only ½ that of the former. Combining all the three foregoing elements of size, namely, length, breadth and depth, we find that strength of a beam of any given material and size is in proportion to its

$$\frac{\text{breadth} \times \text{square of depth}}{\text{its length.}}$$

Now, in order to apply this formula to beams of different kinds of material we call to our aid the results of experiments. Thus for instance: We find that a wrought iron bar 1 inch square and 1 foot long, supported at one end and loaded at the other, will require about 600 to 700 pounds to break it. These figures obtained by experiments are called constants; and hence, to find the weight which will break a beam of any other dimensions, we have the following formula: Let B stand for breadth in inches, D the depth in inches, L the length in feet, C the constant in pounds, and W the weight or load in pounds.

$$\frac{B \times D^2 \times C}{L} = W$$

Example: What weight will break a wrought-iron beam 2 inches wide, 3 inches deep and 4 feet long

$$\frac{2 \times 3^2 \times 600}{4} = \frac{2 \times 9 \times 600}{4} = 2{,}700 \text{ pounds.}$$

Since the weight of the beam will assist to break it, we must deduct ½ of the weight of the beam from the answer found. If we wish to find the load which a beam will support with safety we employ the same rule as before, but instead of using the former constant we only use 1-5 or 1-6 of the same, that is to say, we adopt a factor of safety of 5 or 6; sometimes a factor of 10 is used, depending on the conditions in which the forces act. The constant for the different kinds of material can be found in any good engineer's pocket book. It should also be remembered that the foregoing rules are only applicable to quiescent loads. Having established the formula

$$\frac{B \times D^2 \times C}{L} = W$$

we can easily establish formulas for finding any one of the dimensions of the beam. Thus, suppose we know the length and depth of a beam, then to find the breadth, we have

$$\frac{W \times L}{D^2 \times C} = B$$

Or, if we wish to find the depth, all other dimensions being given, we have

$$\frac{W \times L}{B \times C} = D^2 \text{ and } D = \sqrt{D^2}$$

To find the length we have

$$\frac{B \times D^2 \times C}{W} = L$$

Beams should never be loaded beyond their elastic limits, and therefore it is not always best to adopt a constant obtained from the ultimate strength of material, but should be one which conforms to the elastic limit.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Adv., page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa. Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and patternmaking. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

For Electric Recording Steam Gauge, write Telemeter Co., 44 Barclay st., New York.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

For catalogue of 2d hand lathes, planers, etc., write to John Steptoe & Co., Cincinnati, O.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"How to Keep Boilers Clean" A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Buy the Excel Upright Drill; sizes 20", 25", 28", 32", 36" swing. Currier & Snyder, Worcester, Mass.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Berryman Patent Feed Water Heater and Purifier, and the Economic Boiler Feed Pump. Benj. F. Kelley, 91 Liberty st., New York.

Nicholson & Waterman, Providence, R. I., one 46 in. horizontal boring mill; 5 in. cutting-off machines; 14, 16, and 30 in. engine lathes.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa

Quints' Pat. Auto. Steam Engine Governor. Correspondence solicited from mfrs. of Throttle Gov'nr Engines. Leonard & McCoy, 118 Liberty st., N. Y.

The Brown & Sharpe Mfg. Co. have placed at No. 23 S. Canal st., Chicago, Ill., a sample line of milling machines and other machinery with S. A. Smith.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.: in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Jan. 14, p 14. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet, illustrating pumping machinery and reports of duty trials.

For practical working drawings of machinery call on A. K. Mansfield & Co., 280 Broadway, N. Y. Lifelong mechanics; one formerly R. R. superintendent motive power. Important references.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue E. & F. N. Spon, 35 Murray st., N. Y

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

Fraser & Archer, general machinery dealers, have an excellent assortment of 20, 25, 26, 28, 36 and 38 inch upright drills in stock, which they are offering at extremely reasonable prices. It will pay any one in need of drills to communicate with them before making their purchases elsewhere. Any one interested in iron and wood machine tools would be repaid by a visit to inspect the complete line at their warerooms, No. 121 Chambers st., N. Y.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October, 23, 1886 issue, and up to and including January 14, 1888 issue, 41 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 56 articles have thus far appeared up to and including the January 21, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

MANUFACTURES

Henderson, Ky., will put in a million gallon pump to furnish water.

Robert Manly is interested in building architectural iron works at Dalton, Ga.

James Gibbs is interested in building a foundry and machine shop at Raphne, Va.

The Vicksburg (Miss.) Spoke Works and Ginnery, recently burned, will be rebuilt.

W. F. Remington is interested in building a door, sash and blind factory at Durham, N. C.

J. W. Cooper and others contemplate building a large piano manufactory at Atlanta, Ga.

J. M. Odell is one of the parties interested in building a cotton mill at Salisbury, N. C.

The Eastern Forge Company, Portland, Maine, will build a machine shop and forge works.

The Standard Iron Works, Minneapolis, Minn., will remove their works to West Superior, Wis.

Graff, Hugus & Co., large stove manufacturers of Allegheny Pa., contemplate building large shops.

The Norfolk and Western Railroad Company contemplate building an elevator at Petersburg, Va.

The Mancelona (Mich.) Oval Dish factory, giving employment to 250 hands, was lately destroyed by fire.

The saw mill of G. B. Woodworth, at Tilton, Ga., recently wrecked by a boiler explosion, will be rebuilt.

The Farmers Co-operative Manufacturing Company expect to build a cotton-seed oil mill at Tarboro, N. C.

A company to be known as the Montgomery Manufacturing and Industrial Aid Association is being formed at Montgomery, Ala.

The Consolidated Fire Extinguisher Company has been chartered at Ashland, Ky., to manufacture and sell fire extinguishers and chemical engines.

Goldthwait & Ellis, North Guilford, Me., will build a steam saw mill this winter. They have a large contract for lumber from the Canadian Pacific railroad.

The Chattanooga Cement Manufacturing Company has been formed at Chattanooga, Tenn., to manufacture cement from furnace slag. The company will at once erect large shops.

Claus Spreckles has accepted a site of thirty acres at Watsonville, Cal., for a $500,000 beet sugar factory, and will build at once. He will also build similar works in other parts of the State.

The large saw and planing mills of Newman & Spanner, at Ironton, Ohio, recently destroyed by fire, will be rebuilt upon an enlarged scale. A large amount of machinery was destroyed by the fire.

It is announced that the works of the North Chicago Mill Company, which have been closed for some time, will be reopened in about two weeks and that over 200 additional mechanics, besides the large force of the company, will be given employment.

The Beckett & McDowell Mfg. Co., Arlington, N. J., builders of steam engines and mining machinery, have just finished the erection of a new foundry 50 x 100 feet, and propose giving special attention to the supply of machinery castings. They will put up an erecting shop in the spring.

The Baltimore (Md.) Incandescent Gas Light Company, capital stock $50,000, has been incorporated by George W. Lynch and David Z. Evans, of Philadelphia, Pa., and James R. Hunter, James Hutchinson and William Sinclair, of Baltimore. The present office of the company is at 608 Spring Garden street, Philadelphia, Pa.—*Manufacturers' Record.*

Henry R. Worthington, New York, has issued a new and enlarged catalogue of pumping engines, steam pumps and hydraulic machinery. The catalogue is very fully illustrated with cuts of a great variety of pumps for all kinds of service, pumping engines for water supply, water meters, independent condensers, etc. The cuts are fine, and the descriptions brief and to the point.

A correspondent of the *Springfield Republican* writes from St. Joseph, Mo.: "As inducements to both merchants and manufacturers desirous of a suitable place to locate, they can find here the following: First, an abundant supply of water cheap; also the best facilities for location, and switching arrangements unexcelled; large quantities of good coal near at low prices. They will receive every aid and encouragement from the live element of the city."

New water-works or the enlargement of old ones are contemplated at Frankfort, Mich.; Newport, N. H.; Porterville, Cal.; Austin, Tex.; Welland, Can.; Coxsackie, N. Y.; Baltimore, Md.; Washington, Ohio; Mount Vernon, Ill.; Abington, Mass.; Delaware, Ohio.; Riverside, Cal.; Beaumont, Tex.; Kingston, Ont.; Dover, N. H.; Grand Rapids, Mich.; Sidney, Ohio; Fairhaven, Mass.; Boothbay, Me.; Cucomonga, Cal.; Perth Amboy, N. J.; Niles, Ohio; Mraion, Va.; Senegal, Cal.

The American Brake Company, St. Louis, Mo., send us an artistic catalogue, devoted to locomotive brakes. The advantages of the brakes made by this company are modestly but clearly set forth in the catalogue, and large plates employed to show the arrangement of brakes for various kinds of locomotives, as well as complete details of the parts. These details are an interesting part of the engravings, showing as they do the whole construction. They are all numbered to assist in ordering parts. The directions to be observed in ordering brakes are very clear.

The *Northwestern Miller's* annual review of the milling industry in Minneapolis, Minn., shows that the year's product of flour will be 6,615,700 barrels. The receipts of wheat for twelve months, to December 1, have been 45,577,190 bushels; the shipments 12,337,700, against 32,832,020, and 5,729,750 respectively last year. The storage capacity of the city is 14,177,000 bushels, and of the Northwest 85,300,000 bushels. The mill capacity is 6,635 barrels of flour a day. The cooper shops made 2,740,950 barrels during the last crop year, and 888,500 in the last three months.

Regarding the dissolution of the firm of Brehmer Bros., Philadelphia, which we have previously referred to, the following from Hugo Bilgram will explain itself: "As successor to the firm of Brehmer Bros., I shall continue the business as heretofore, paying personal attention to the manufacture of special machinery, to general machine work, and especially to the cutting of theoretically correct gearing. It shall be my endeavor to give thorough satisfaction to those who desire accurate work at reasonable rates." The dissolution was by mutual consent, Mr. Bilgram taking all the accounts and the good will of the retiring partner, Hugo Brehmer.

The Noblesville Foundry and Machine Company, Noblesville, Ind., is a new corporation formed on the joint stock plan for the manufacture of pipe tools and fittings in brass, also a general machine business. Mr. H. L. Smith, of Indianapolis, is president; A. M. Baker, secretary and treasurer, and John Haileran, superintendent. The shops are of brick, of the latest style, and well equipped. The plant consists of the entire plant of the Indianapolis Steel Wrench and Tool Works, and a repair shop removed from Newcastle. Capital stock, $25,000. The citizens have donated the use of the "Beamers" natural gas well, as long as gas exists. The plant will be in operation before the first of February.

Machinists' Supplies and Iron.

New York, Jan. 5, 1888.

Iron—Transactions in American Pig have been light, being interfered with by the usual holiday interruption. Manufacturers have made no announcement for the year, and buyers are holding back in consequence. Standard Lehigh brands, No. 1 X Foundry are quoted $21 to $21.50; No. 2 X $19 to $19.50; Grey Forge, $16 to $17.

Scotch Pig—Coltness, $22 to 22.25; Glengarnock, $21 to $21.50; Gartsherrie, $21.50 to $22; Summerlee, $21.75 to $22; Eglinton, $20 to $20.50; Langloan, $20 to $20.50; Dalmellington, $21 to $21.50; Clyde, $20.50 to $21.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 11.

Wanted—A machinist who can do lathe, planer and vise work. Cary & Moen, 234 W. 29th st., N. Y.

Wanted—Position as traveling salesman with machinists' supply or tool house; references and bond. Box 677, Sparta, Wis.

Wanted—Machinist with experience on cylinder printing presses. Address, stating age, experience, and salary required, Golding & Co., Boston, Mass.

Wanted—A teacher of joinery and wood-turning in a boys' school. Address, with credentials, H. H. Belfield, Michigan ave. and 12th st., Chicago, Ill.

Wanted—Situation as foreman blacksmith; locomotive work preferred; great experience in Europe and America; great saving guaranteed; distance no object. W. J., Am. Machinist.

Well-known machinery salesman desires immediate engagement; large acquaintance with steam users in Eastern, Middle and Southern States; reference first class. Address Engineer, Am. Machinist.

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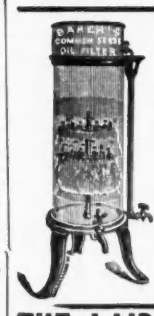

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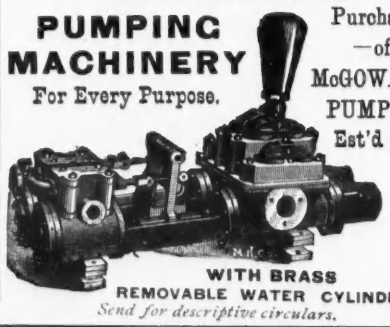

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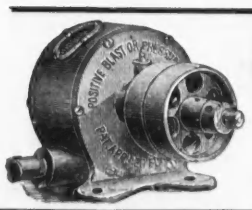

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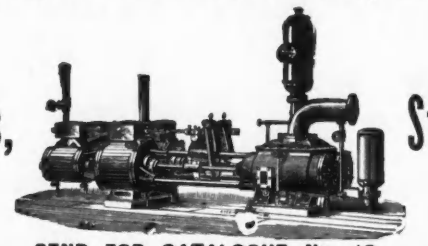

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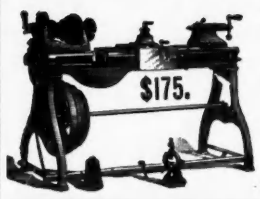

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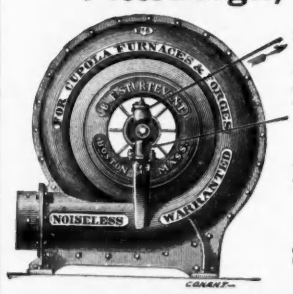

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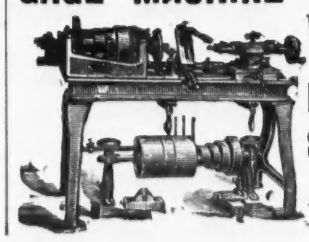

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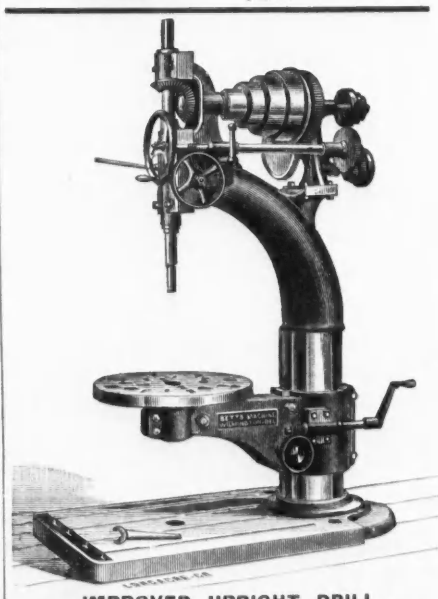

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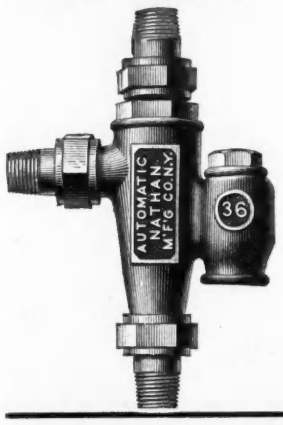

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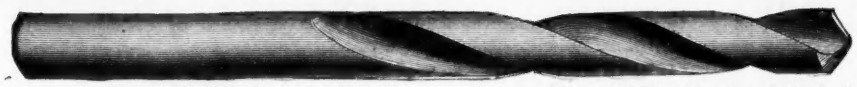

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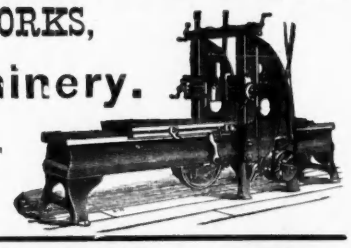

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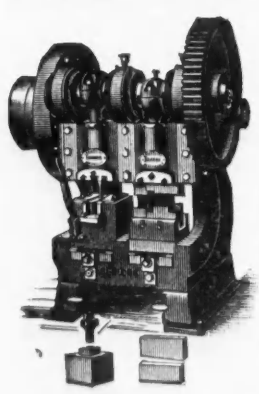

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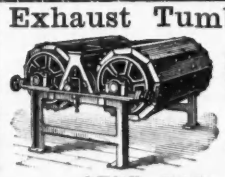

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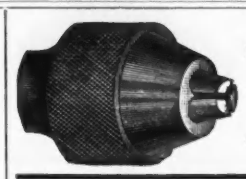

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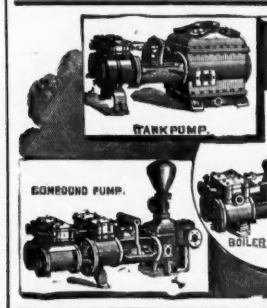

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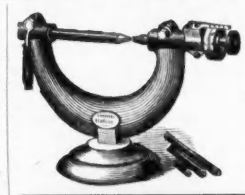

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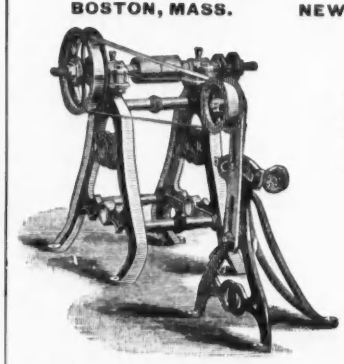

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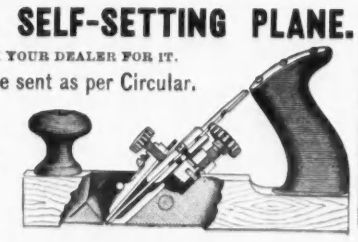

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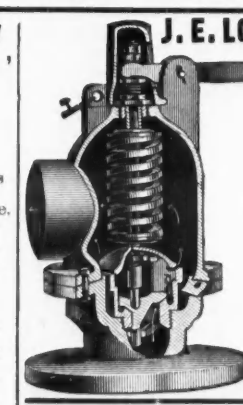

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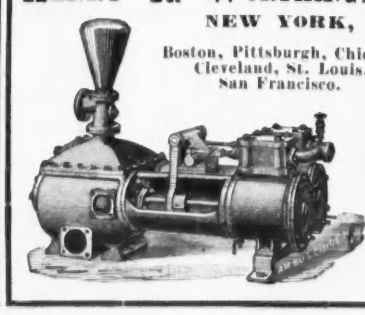

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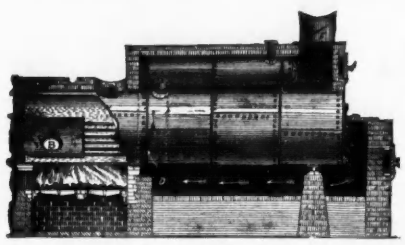

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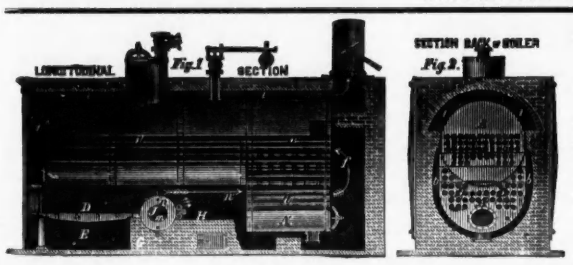

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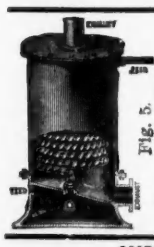

Fig. 5.

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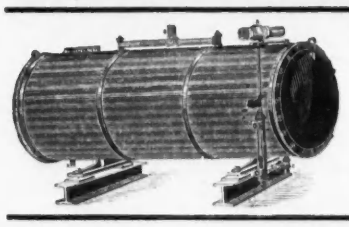

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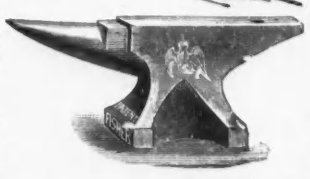

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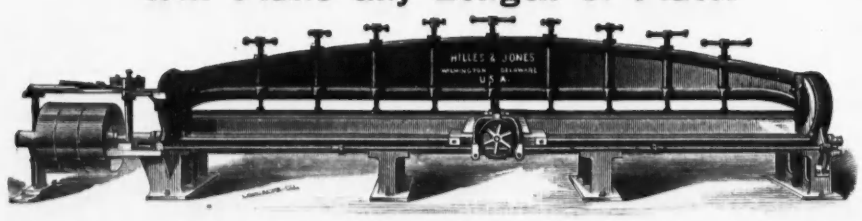

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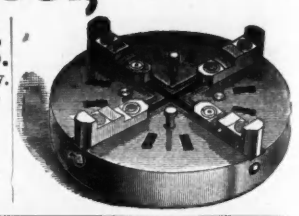

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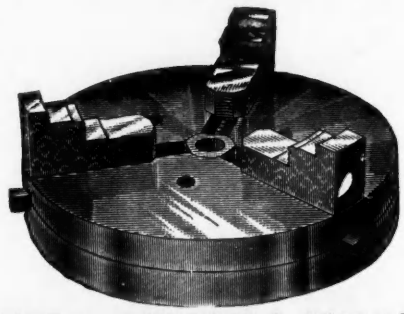

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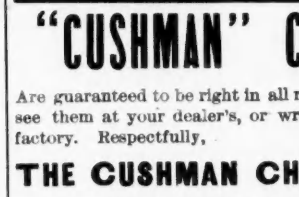

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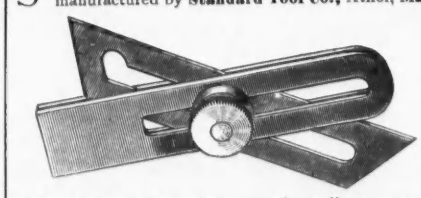

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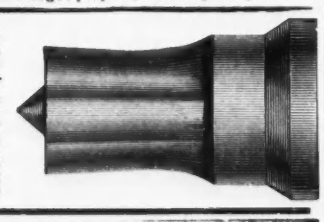

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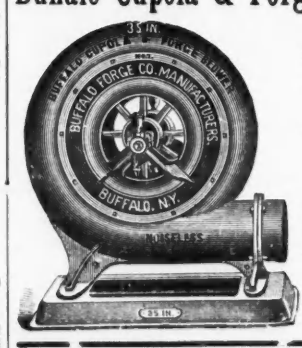

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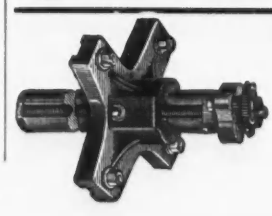

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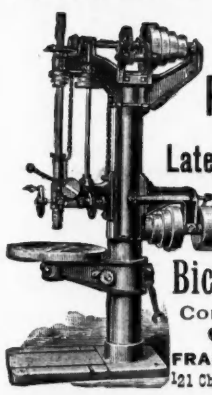

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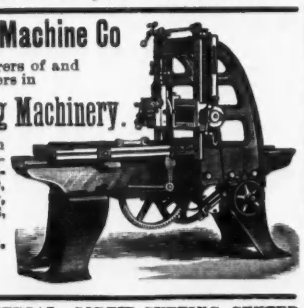

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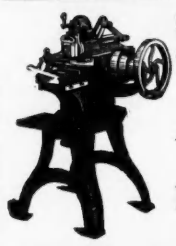

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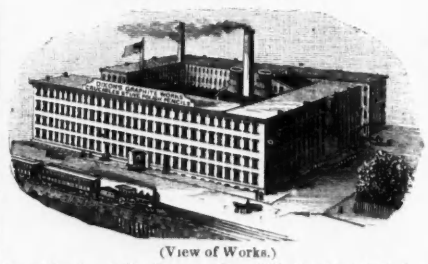

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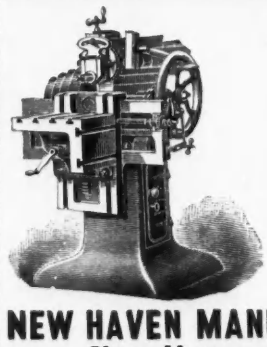

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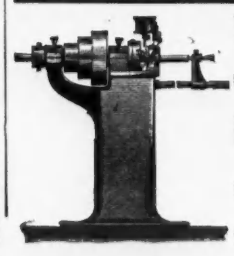

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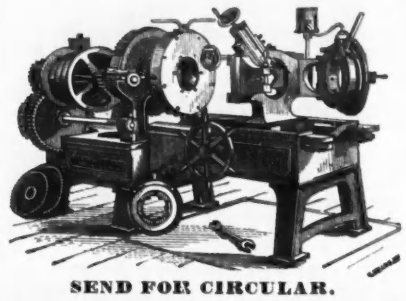

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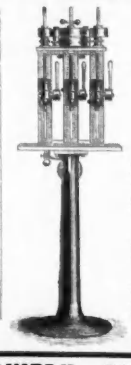

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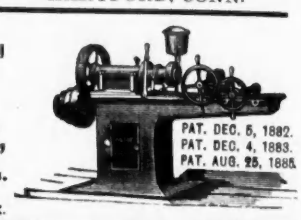

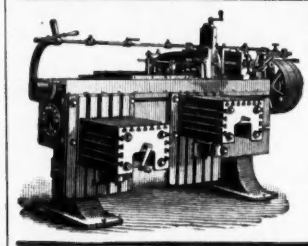

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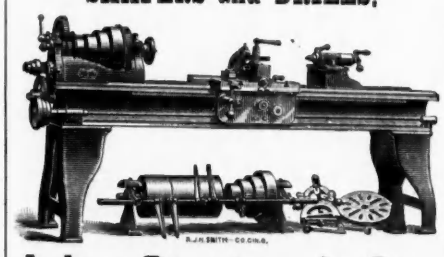

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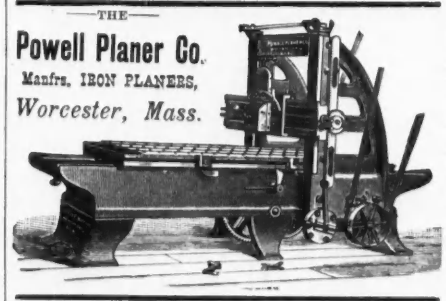

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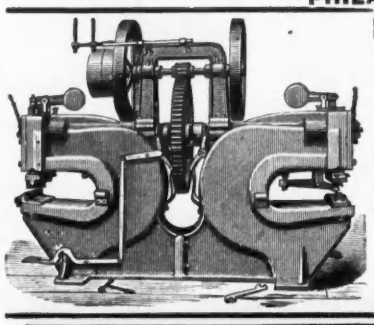

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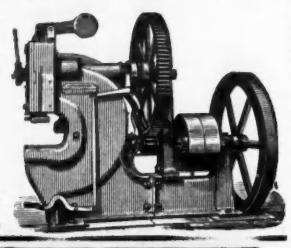

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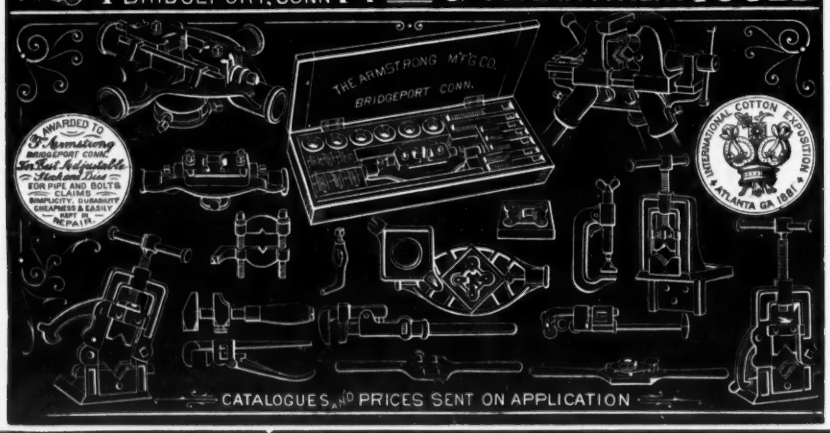

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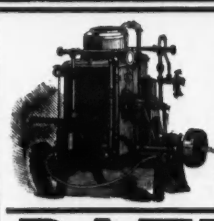

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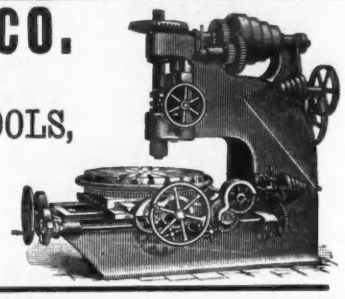

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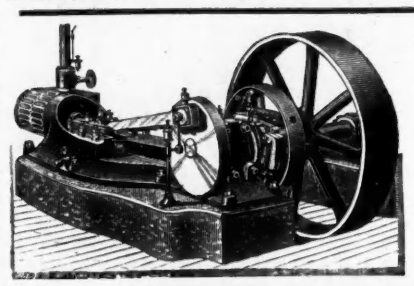

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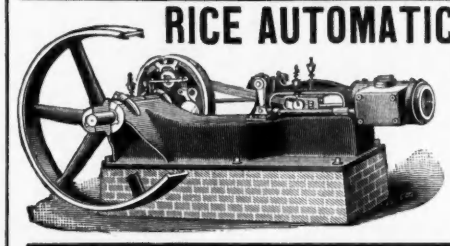

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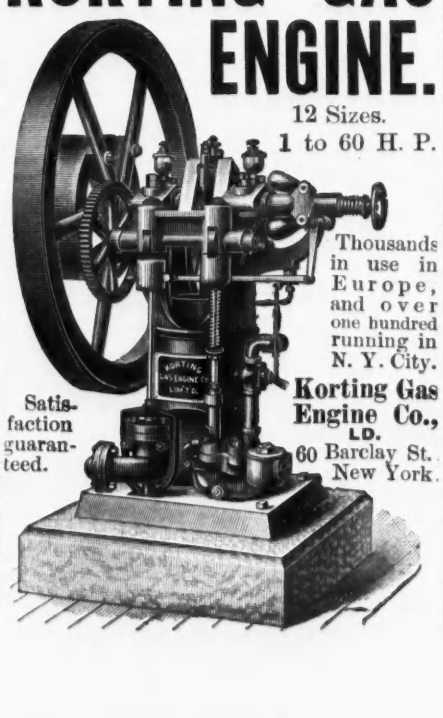

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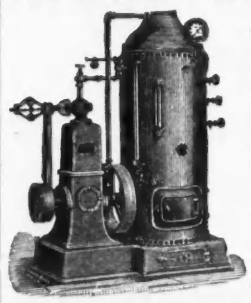

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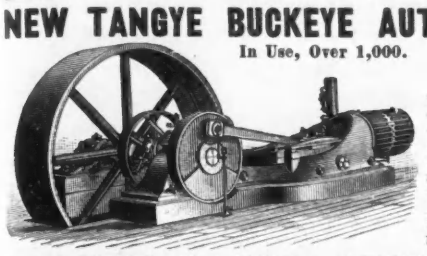

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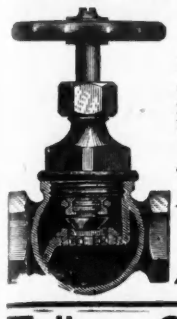

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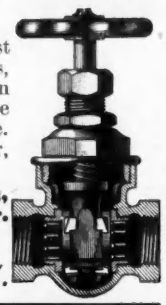

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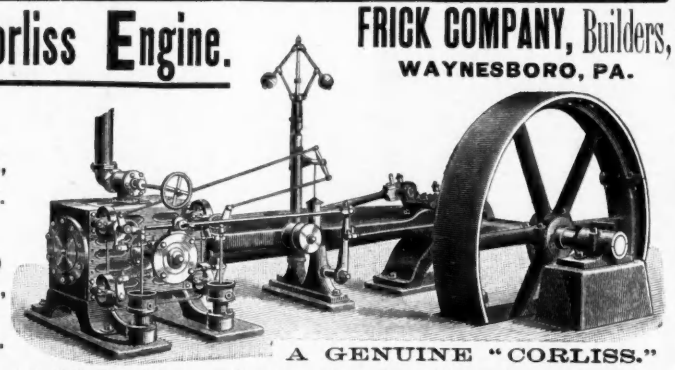

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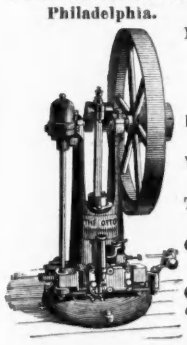

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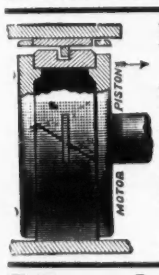

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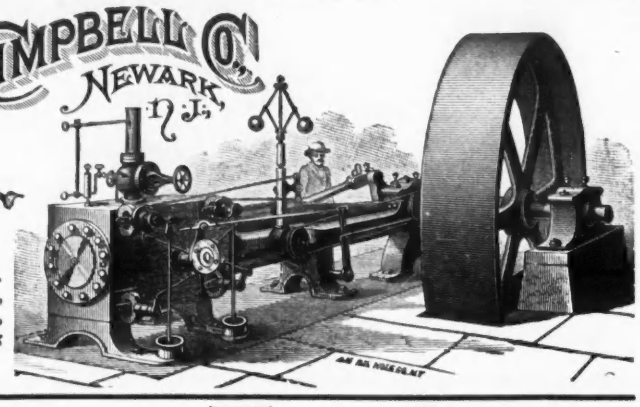

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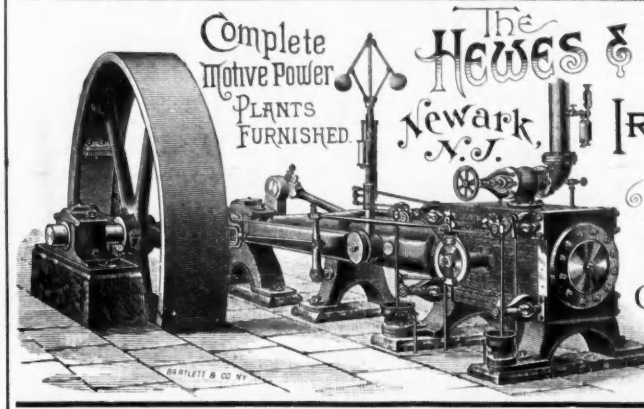

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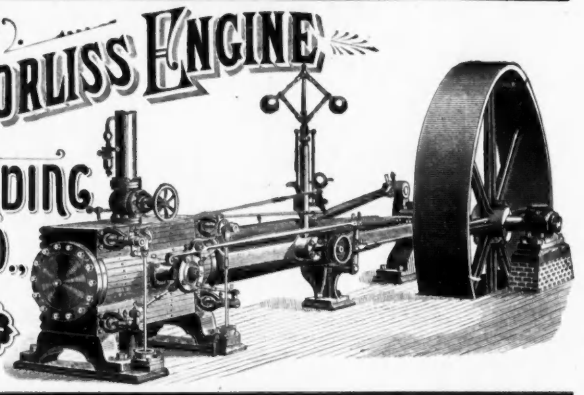

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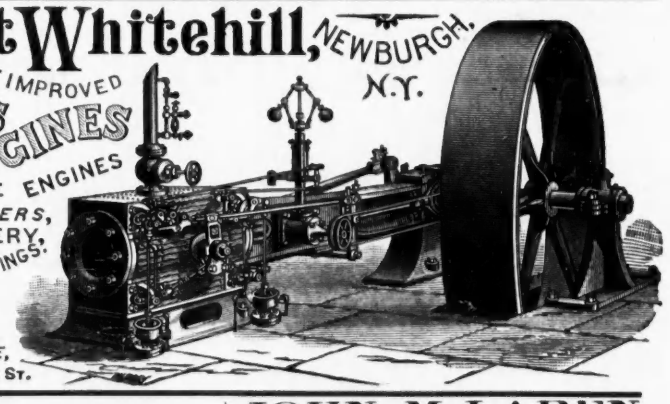

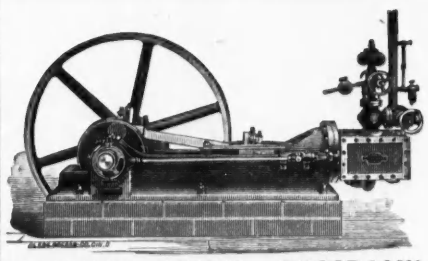

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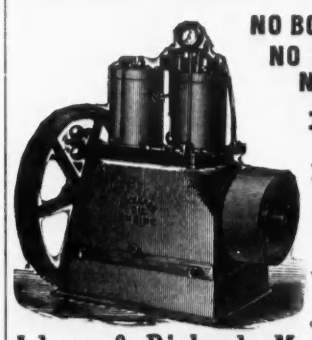

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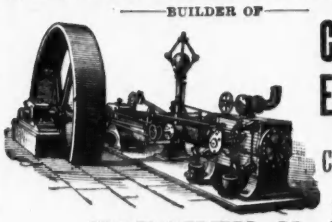

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One New Putnam Screw Cutting Engine Lathe, 36" Swing, 18' Bed.

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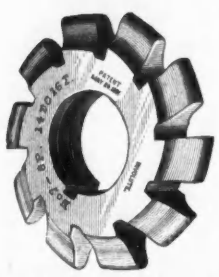
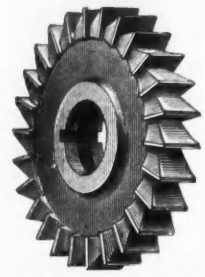
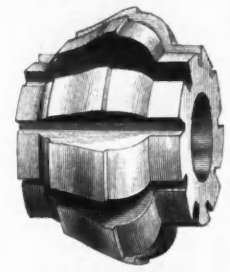


INVOLUTE GEAR CUTTER.



SIDE MILLING CUTTER.



FORMED CUTTER.

Coincident with the rapid and wide extension of the use of Milling Machines, has come an increased demand for Milling Cutters. Without good cutters, the efficiency of Milling Machines is much abridged.

In extending the product of its Milling Department, the BROWN & SHARPE M'F'G Co. has made many new varieties of Milling Cutters, and in order to supply the wants of customers, has found it necessary to greatly increase the number carried in stock. The INVOLUTE GEAR CUTTERS in stock are from 3 to 48 pitch, 8 cutters to each pitch. The Epicycloidal are from 2 to 10 pitch, 24 to each pitch. The curves of gear cutters are obtained by machinery. SIDE MILLING CUTTERS, from 3 1-2 in. to 8 in. diameter, are carried in stock. On work having parallel surfaces, these cutters may be used in pairs FORMED CUTTERS, for cutting various outlines, are made to order. These, as also the Gear Cutters, can be sharpened without changing their original form—a feature appreciated by those producing work in duplicate. By making cutters in large numbers, with expensive special tools, much greater accuracy has been attained than can be reached by the usual methods of manufacture. Users of cutters will generally find it more economical and satisfactory to purchase from experienced makers, rather than to attempt to manufacture for themselves. Catalogues mailed on application. All kinds of cutters made to order.

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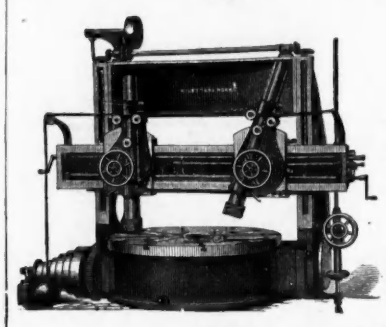

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—WITH—

Weston's Differential Pulley Blocks.

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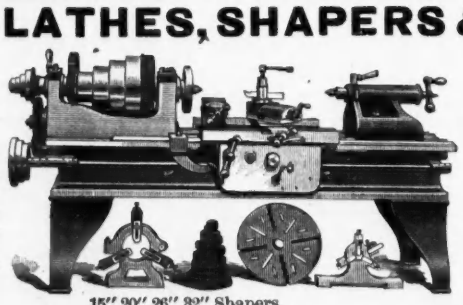

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17″ 19″ 21″ 24″ 27″ Engine Lathes.
20″ 24″ Upright Drills.
25″ 28″ 32″ 40″ B. G. P. F. Drills.

26-INCH BACK GEARED AND POWER FEED DRILL.

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(See "Important" Notice of Engine Lathes on page 15.)

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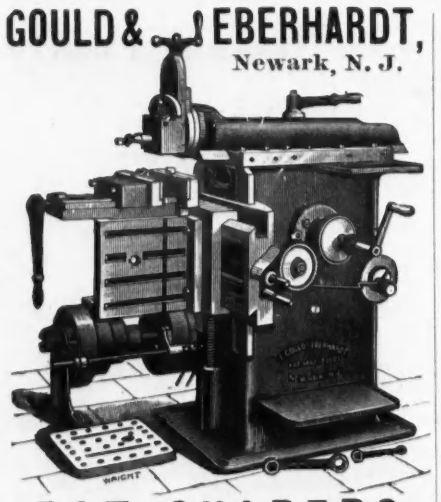

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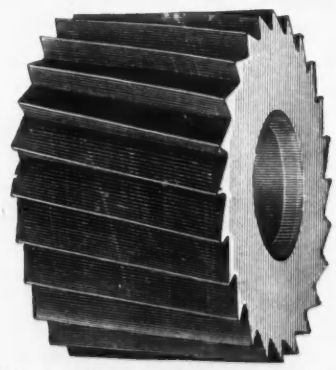

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Straight or Spiral Teeth. Width of face, 1-8 in. to 3 in. Diameter, from 2 1-4 in. to 2 3-4 in.

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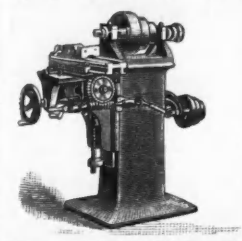

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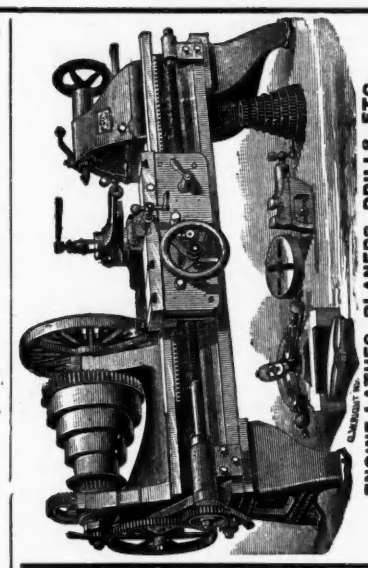

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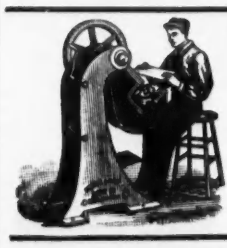

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